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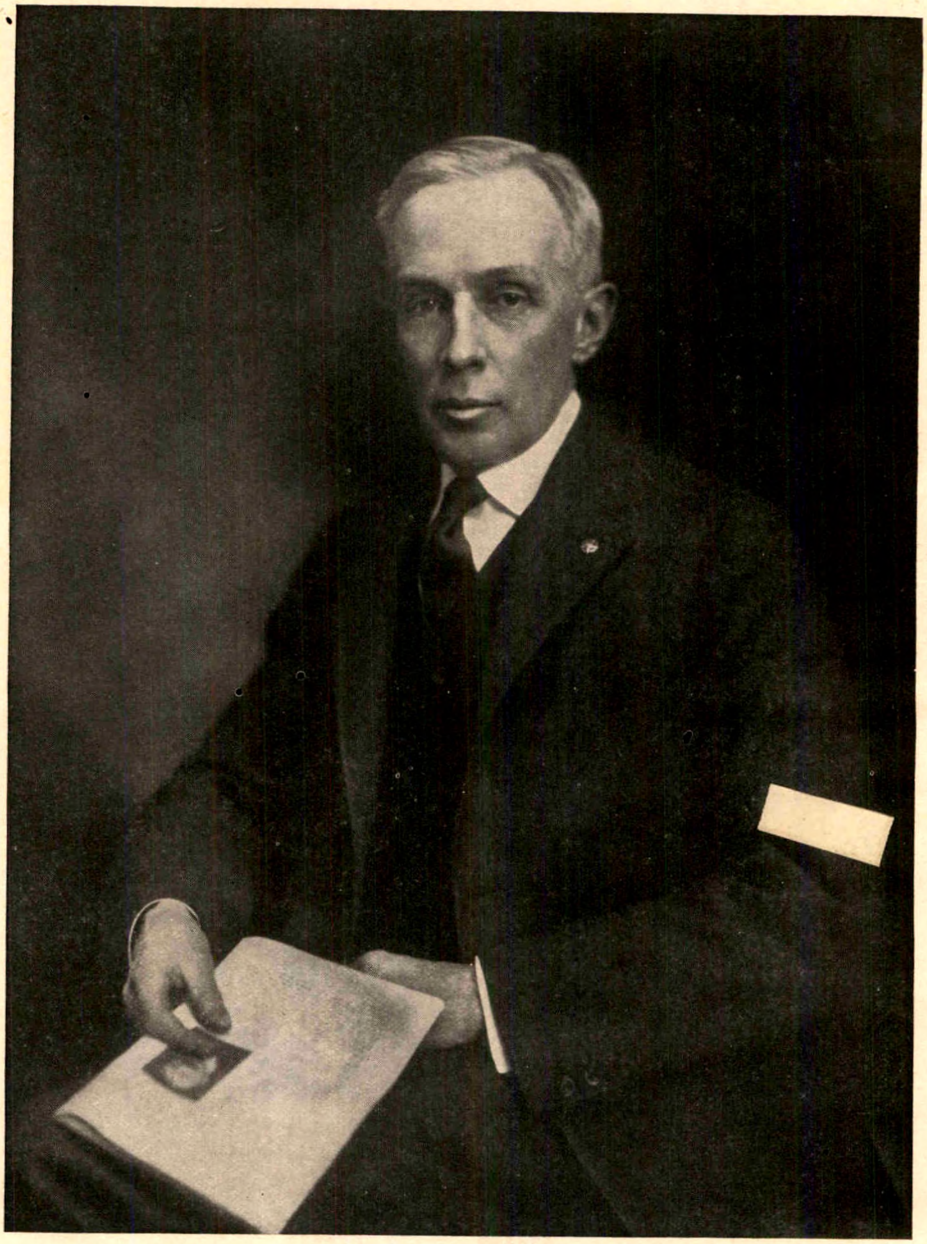

Percy Brown

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SOME ASPECTS OF THE CANCER PROBLEM*

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LONDON, ENGLAND

MOST important work has been done in cancer therapy since the fact was recognized that with penetrating radiations of roentgen rays and radium rays it was possible to reach practically any depth of tissue.

Attention has been riveted upon the means to be adopted in order to reach this end, and much valuable physical investigation and mechanical ingenuity have been expended for the furtherance of this desirable object. The so-called "lethal dose" has been worked out with a precision that must command our admiration; not only has the lethal dose for cancer been determined, but also that for sarcoma and tubercle, and it has even been determined for most of the normal tissues. There would, therefore, appear to be little more to do than to administer the particular dose for any of these tissues and await the result. The cure of cancer would be within our reach if the claims put forward contained even a modicum of truth. How far we are from so desirable a consummation it will be my endeavor to show in the course of this paper.

One of the master minds in radiology, in a paper communicated at Los Angeles last September, put his finger on the crux of the problem when he stated: "It is not we, but the particular form of tumor which determines whether or not our treatment will be successful." I refer to Professor Guido Holtzknecht, who communicated a paper on "A Review of the Present Status of Deep Roentgen Therapy."

I would go a step further and say it is not even the particular tumor which controls the effect, but its condition, or stage of progress at the moment it receives the appropriate dose of radiations, which will determine the response. There may be a period in the life of a tumor at which it is susceptible to the rays, and that period may be of extremely short duration. If attacked during its responsive state, it may react favorably.

In addition to the condition of the tumor it is also necessary to consider the response of the surrounding tissues; if these are capable of a good reactive response, the chance of effecting an improvement in the condition is greater. The blood is a factor which must also be reckoned with; normal blood is a better medium than that which is impoverished. Nearly all the cases which have yielded to treatment showed a good normal or plus normal blood count.

THE LIFE CYCLE OF A TUMOR

The life history of a tumor is interesting from any point of view, but from none more than the radiological. The majority of tumors we are called upon to treat, are, from the point of view of biological response, beyond our reach. It is useless to irradiate a tumor which is already undergoing extensive though slow necrosis from interference with its blood supply, or one where an extensive degree of fibrosis has already taken place, for that which we would seek to achieve by treatment has already been done by the tumor and the surrounding tissues. Mr. W. Sampson Handley, whose book on "Cancer of the Breast and its Treatment" teams with practical points of great significance and value, draws attention to what he calls "an unrecognized law in cancerous growths." He states that: "Every aggregation of cancerous cells has a definite life cycle, and after increasing in size for a varying period and at a varying rate, tends spontaneously to undergo degenerative and fibrotic changes. These changes extend from the center of the mass centrifugally to its periphery, lead to its shrinkage, and terminate in the replacement of the aggregation of cancer cells by a fibrous scar. In other words, the natural history of a cancer is one of centrifugal growth followed by centrifugal death.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

"To avoid misconception it will be well to state at the outset that the natural cure in cancer is a local, and not a constitutional, process, and that as a rule it closely follows up, without overtaking the centrifugal spread of the permeation, and so fails to arrest the march of the disease. It is certain that in some cases its vigor is sufficient to strangle the growth in an early stage, or to reduce it to impotence for a long period of years; but as a rule, the natural processes of cure go on contemporaneously with the active advance of the disease in other parts of the body farther removed from the primary focus."

Handley gives in full detail the life cycle of a tumor, its method of spread, and, in a number of diagrams, furnishes most illuminating details of the progress of growth. Space allows only a brief reference to his work.

To appreciate fully the difficulties of the practical application of radiations in the treatment and cure of malignant disease, it is necessary to consider more than the life cycle of the tumor. The life cycle of the surrounding normal cells as well as the malignant, must also be studied with care, for it is upon an intelligent appreciation of the life duration of the cells, their intricate construction and physiological processes that success in therapy may depend.

BIOLOGICAL RESPONSE AS A GUIDE TO DOSAGE

Biological response must become one of the factors of dosage, and it is very clear that it will always be the determining factor. All our efforts should be concentrated upon a study of this most important factor. If a fraction of the time spent upon the physical measurements had been devoted to the biological processes, important points might have been worked out. New methods and experimental technique must be devised for ascertaining these points. Systematic blood counts on a large number of cases would yield valuable information, while an estimation of the coagulation coefficient proves another valuable aid to the study. By systematic examination is meant that a number of patients who have had a measured dose should be kept under constant observation, counts being taken at regular and short intervals over a long period of time. High-power magnification of the blood constituents, particularly the nuclear changes, would also be helpful. A clear appreciation of the function of the nucleus and the changes induced in it by radiation and other forms of stimulation might give the clue to the biological response of cellular structures.

Dr. Drew of the Imperial Cancer Research Fund has published several papers lately which give us a very clear indication of the lines upon which the biological response should be investigated. He has shown that tumor strains and normal tissues can be cultivated in vitro. A study of a few examples of his work will help us to understand the processes of growth and the effects upon the normal tissues of the introduction of a tumor strain. An ingenious method of separating a particular type of cell gives a striking example of the effect of radiations upon cell growth. It consists of placing on a slide the particular culture containing the cells to be isolated, covering the area containing the cells with a globule of mercury, and exposing the slide to ultraviolet radiation. All the cells except those under the globule are killed. The mercury is then removed and the cells placed in a culture medium. Any form of cell appears to be killed if the radiation is sufficiently prolonged in its action. Dr. Drew describes several methods for obtaining pure cultures of tissues and tumors:

1. *Mechanical Separation.* This process was originated by Carrel.

2. *Separation by Ultraviolet Light.* This may be described as probably the best method of separation for cultures in the saline medium, as after a few failures pure cultures can be readily obtained. A series of cultures of the selected tissue, for example, kidney, are examined daily till vigorous growth takes place. In one or more of any series of cultures pure kidney cells will be found growing free from connective tissue elements in certain portions of the growth. A minute globule of mercury is then carefully pushed onto the preparation and so arranged as to cover the selected cells. Provided the globule is not too large, it will be found to remain in position fairly well. The slide is then removed from the microscope and placed under a mercury-vapor lamp, care being taken that it does not become heated. After an exposure of from five to ten minutes it is removed, fresh culture medium added, and the slide returned to the incubator. On examination it will be found that the cells unshielded by the mercury have been killed, and growth, which is pure in character, is taking place from the small fragment shielded. With care the same technique may be applied to plasma culture, but here it frequently fails. It is best to grow the cultures intended for this separation on quartz cover-glasses.

This work by Drew is full of points of great interest to the radiologist, and if the results attained by him can be repeated by a number of workers, a useful aid to the study of biological reaction will be available. It should be possible to study the natural processes of repair by Drew's methods, and side by side with the study, a series of experiments with radiations of different wave-lengths and intensities could be carried on.

TUMOR RESPONSE TO RADIATION

From the nature of tumors, their condition when exposed to radiation, and the uncertainty of their biological action, it is apparent that only a small percentage is likely to respond favorably to treatment. This is what actually happens in practice; a small percentage of striking results occur in everyone's experience. It is from a careful analysis of all the factors at work in these favorable cases that we should be able to arrive at a correct estimation of the probability of effecting a cure in cases suitable for the treatment.

The environment of a tumor, as well as its structure, may also be a favorable factor. Tumors situated in certain regions of the body appear to be, as a class, more readily influenced than those in other regions.

EXPERIMENTAL PRODUCTION OF CANCER

It may be profitable to turn aside, for a moment, from the main thesis of the paper to consider briefly the work that has been done in the experimental production of cancer and other forms of new growth.

Roentgen-ray cancer is too well known to require much description; it is or has been common in early roentgen ray workers, yet it is apparently very difficult to produce experimentally in animals. Malignant growths are readily produced by chronic irritants, such as coal tar, arsenic, etc. Most valuable work has been published in recent years on this profitable field of research. The works of Fibiger, Murray, Leitch, Kennaway and others should be studied very carefully in this relationship; much valuable information will be obtained, which throws light upon the problems upon which we are engaged.

My colleague at the Cancer Hospital, Dr. Archibald Leitch, has shown experimentally on animals that if after a certain stage of irritation of the skin has been induced, the application of the irritant is suspended, the growth goes on to the formation of papilloma and cancer. Leitch summarizes the results of his experiments as follows:

"These experiments show clearly that when tar has been applied repeatedly for a certain length of time, and the irritant is then removed, tumors, even carcinomata, may make their appearance at a later date. It must be that the irritation produces in the normal cells subjected to its influence, some profound change undetectable by the microscope, so that the cells eventually proliferate in an unrestrained and in a harmful fashion. We may conclude that the neoplastic response to an irritant is a slow tissue reaction that exhibits no defensive property, that subserves no useful function. The internal changes in the cells in the earliest stages may some day be analyzed—at present they are unknown."

Murray makes an important observation when he states that animals which have been previously tarred, and had responded with cancer formation, failed to respond after a second series of tar application. The observation of Leitch is supported in clinical practice by the fact that if, after a long series of treatments have been given, the treatment is stopped, the action may continue for some time; in several cases it was many months.

A number of patients with fibromyoma, who apparently did not receive any benefit from treatment, reported several months after cessation of treatment that the results aimed at had been attained. One case of atrophic cancer of the breast was treated intermittently for about eighteen months with no appreciable change. Treatment was suspended. Four months later the tumor had disappeared except for a small nodule in the upper angle of the right side of the growth. At a later date there was a recurrence of the growth.

The action may be of the same nature as that described by Leitch: biological processes initiated by the irritant in the case of the animal experiments find an analogous action in the example of growth treated by radiations, in that biological processes set going by the radiations appear to go on after the cessation of treatment. If the true interval can be gauged, and a series of doses given at appropriate intervals, the action may be carried on over a long period of time.

Working on a theory of this kind, we have, at the Cancer Hospital and King's College Hospital, been administering doses of considerable magnitude at intervals over long periods, with relatively satisfactory results.

The publication of the work by Seitz and Wintz and others, and the advocacy of the lethal dose with its attendant consequences resulted in a reconsideration of our position, particularly in regard to cancer.

THE LETHAL AND THE STIMULATING DOSE

Seitz and Wintz, in their work on the "Treatment of Cancer and other Tumors," estimated the lethal dose for each form of tumor, and stated that a dose short of the lethal one, say 40 per cent of the estimated lethal dose, is a "stimulating" one, and we are told that if such doses were administered, the tumor would grow as a consequence of having been so stimulated. It is true that since living tissues are concerned, growth must go on; it may vary in its rapidity, and finally become stationary, or it may progress slowly and finally become retrogressive. When a tumor is actively growing, it must be a difficult matter to say when it is actually stimulated by radiations. What appears to be a stimulating effect may after all be only an acceleration of growth quite independent of any extraneous stimulation. It is certainly proved beyond any doubt that a number of cases have been cured or kept from showing increase by the use of the small doses administered at frequent intervals; these, if estimated by modern standards, would undoubtedly come under the heading of stimulating doses. What explanation can be given of this apparent contradiction?

A term "summation of dosage" might be used to explain the action. If a daily fractional dose be given for several days, and all doses are equal, then in so many days a full dose will have been reached. In several weeks' time a good many lethal doses will have been administered. At one period of the treatment the tumor may show signs of retardation. It has been in some way induced to change its activity. The change may be caused in one of two ways: (1) a direct effect upon the tumor cells, with devitalization of these, and subsequent death. If a very large number of cells receive this dose simultaneously when they are in a similar stage of activity, the result will be the same in all, namely, a local death of a large mass of cells. The normal tissues, the lymph channels, and the phagocytes of the blood stream will carry away the debris, and so the tumor recedes in size. (2) Stimulation of the defensive forces may also induce a similar change in the tumor. It is probable that both are in action at the same time. Apparently a stimulating dose may act upon tumor cells and normal cells to a degree which is determined by the resistance of the constituent cells, and the intensity and duration of the exposure. The term "summation of dosage" might be applied to the sum of the small frequent doses.

SUMMATION OF STIMULI

If a muscle bundle or other tissue is stimulated electrically it responds vigorously for a time; this is followed by a period of fatigue, and if over-stimulated, the muscle may be exhausted and die. Is it not possible that by the use of frequent small doses of radiations the law of summation of stimuli comes into force? The cells are over-stimulated, and either die or become more vulnerable to the natural processes of repair in the tissues, and are overcome. The balance between the normal and abnormal tissues must always be an uncertain one, depending upon a number of variants too numerous to discuss in detail; yet in almost every case of new growth at some period of its history the normal tissue possesses the power of overcoming the invading organisms.

PRACTICAL APPLICATION OF RADIATIONS IN THE TREATMENT OF CANCER

In relation to cancer it is apparent that, though the local and obvious manifestations of the disease can be removed by either operative or radiotherapeutic measures, in the majority of cases something further must be done before a claim can be made in favor of a cure. Even when a wide dissection has been made, of the primary growth and all possible lymphatic extension, recurrence at a later date is almost invariable. Surgery has obviously reached its limits so far as technique is concerned, and most elaborate dissections are now made. As a result it is probable that a longer period of relief is now obtained between the operation and the recurrence.

COMBINED SURGICAL AND RADIOTHERAPEUTIC TREATMENT

Radiotherapeutic treatment is advocated in all cases operated upon for cancer, and time will show the measure of success following such treatment. It might be profitable in this connection briefly to consider what is the aim of such therapeutic measures. Let us take the example of a carcinoma of the breast, and outline the procedure to be followed, and its probable effect upon the growth. Sir Lenthal Cheatle has described the earliest manifestation of carcinoma as occurring in what he calls the proemial breast, a condition which is a prelude to later developments of papillomata and of duct and acinous carcinomata. This type of breast can be recognized clinically by the presence of cysts, and, in its earlier stages, by the irregularity in the size of a duct or ducts. In Sir Lenthal Cheatle's opinion the condition is carcinomatous, although the epitheloid cells remain within the walls of the duct. Cheatle describes five forms of duct irregularity and states that all are now being diagnosed as chronic mastitis.

It is evident that where so much doubt exists in the minds of pathologists and surgeons regarding the exact description of changes in duct epithelium, there cannot be any radical difference from the normal in the type of the cell, nor in its power of response to stimuli, while the absorption equivalent of the two types of cell will frequently be equal.

The administration of the lethal dose to a few isolated and perhaps newly formed cancer cells must be a matter of great difficulty, if we recognize at all the need for such a discrimination. There can be no specific difference in selection of wavelength in cells possessing the same biological properties and reactions. To kill the cancer cell it would also be necessary to kill the adjoining noncancerous cells, and it would require a very specific and discriminating radiation to distinguish between these types.

Assuming that chronic mastitis is a prelude to cancer, is it not a fact that radiations applied to such conditions often yield most excellent results? In almost all the cases treated the dose is a stimulating one, no attempt being made to give the lethal dose. A technique in which small doses at frequent intervals are given, is frequently successful. If the mastitis is deeply seated, the shorter wave-length must be used, in order to reach the morbid condition and give it a dose in a reasonable time. If such an early condition can be treated, and it is admitted that such are treated, it must follow that in a certain percentage of cases carcinomatous cells are already present when the treatment is given, and it is logical to assume that in such cases a percentage are temporarily arrested by the treatment. The same argument applies to surgery, with the important difference that upon subsequent examination of serial sections of the growth, the presence of carcinomatous cells is proved. This evidence is obtained in a considerable proportion of the cases of mastitis operated upon.

When a surgeon finds evidence of carcinoma, he performs an extensive operation, removing all the lymphatics in the vicinity. The attempt must be made by the radiologist, in all cases subjected to treatment, to emulate the surgeon, and by radiations to lessen the likelihood of a recurrence in the lymphatic chain. If the lethal dose is necessary, this means an enormous dose of radiations applied over areas to include the whole of the breast, the axillary, supraclavicular and mediastinal glands, and an area well below the breast to include the liver and abdominal lymphatics. To achieve this in an early case at one time would be practically impossible on account of the great damage done to the blood constituents. Here again the question of stimulation versus lethal effect has to be considered. Any treatment given must essentially be of the stimulation type, nor from a consideration of the pathological aspects of such conditions would it appear to be possible to administer the lethal dose without locally producing disastrous effects upon the healthy tissues. All that is required is a gentle stimulation of the normal tissues sufficient to induce a slow fibrosis of the lymphatics, and the tissues around them, so that the cancer cell will be included in the fibrous tissue and slowly rendered innocuous.

In the execution of the technique it may be necessary to graduate the penetration in order to achieve these results quickly, the longer wave-lengths being employed for the more superficial structures, the shorter for the more deeply situated; in other words, a progressive selection of wave-lengths may be required for the successful treatment of cancer of the breast. To achieve this end it will be necessary to be thoroughly conversant with the various wave-lengths, and the absorption equivalents before the treatment can be successfully carried out. It is in this connection that we should be grateful to those physicists and technicians who have so greatly helped us in the evolution of a technique possessing such elasticity in execution.

THE SELECTION OF THE WAVE-LENGTH IN THERAPY

The question of wave-length is therefore an important one. Why do we use the short wave-length in therapy? Largely because of the fact that by the use of the penetrating radiation a larger percentage of the beam reaches the deeper structures. We know that superficial cancers of a type similar to those more deeply situated can be removed by long wave-length radiations, and Drew's experiments show that a cancer cell can be killed by the ultraviolet radiation, while Russ has shown that in equal absorption doses the longer wave-length radiation is more effective.

From Russ's experimental results on animals it would appear that for the same quantity of hard and soft rays absorbed, the effect of the softer radiation is greater, and this observation is borne out by experience in the treatment of the human subject. It is not at all established, for example, that the hardest possible roentgen ray, produced at enormous trouble and expense, is essentially the best for the treatment of carcinoma. The radiation which is absorbed by the tissue is the active agent in the production of therapeutic effects. It is probable that with the very penetrating radiation the larger percentage goes beyond the tumor and exercises practically no action upon it. This is also borne out by actual experience in practice.

In the case of some tumors, particularly a tumor of the chest, the effects were induced by the use of a relatively large quantity of medium wave-length radiations, and in the case of a sarcoma of the mediastinum, which was treated first by radium and later by roentgen-rays, the action of the latter appeared to be much more rapid and quite as efficient as when the gamma rays from radium were employed.

It might be laid down as a definite law in radiotherapeutics that the most suitable wave-length for general use should be that which is absorbed in the tissues undergoing treatment. The need for an increase of the penetrating power of the radiation is conditioned by the depth at which the tumor is situated, rather than by any greater effectiveness of the shorter wave-length radiation. As the depth increases the wave-length must be shortened in order to get into the area a sufficient quantity of radiation to influence the tissues. Drew's method for the differentiation of tissue-cells for experimental purposes shows that the ultraviolet ray is equally efficient for the destruction of normal and tumor cells, so long as it can be applied to the tissues in a sufficient dose.

It is not at all my object to attempt to prove that the short wave-length radiation is useless—far from it. The whole range of wave-length from the ultraviolet to the most penetrating gamma ray of radium should be at the disposal of the radiotherapeutist, in such a form that he may use any particular wave in sufficient quantity to produce the result. The most successful will be he who uses the tool at his hand to most advantage, gauging the dose of each value in wave-lengths to suit the condition he treats. Do not let us become obsessed by the idea that to obtain results we must ever increase the output from our apparatus and step by step increase the voltage until we are in a position to turn out roentgen rays equal to the hardest gamma ray of radium in hitherto unthought of dimensions.

An intelligent appreciation of the conditions requiring treatment and of the biological reaction of tissues should enable us to obtain results with much less exacting demands upon our apparatus than would otherwise be the case. Remember that the quantity as well as the quality influences the effect, and that from the results quoted a great deal can be done with what are regarded as "soft rays" provided, always, it is possible to ensure that a sufficient quantity shall be absorbed. The need for intimate knowledge of the biological properties of living tissues, the physiological action of organs, and above all a knowledge of the pathological processes concerned in disease, and particularly in those conditions known as new growth, is evident. Until this has been mastered, little real progress in the radiotherapy of cancer ca[illegible] be made.

It is on this account that the publications of Dr. Drew, so full of significance in the study of cell growth, and the investigations of tumors grown under similar conditions, give a clear indication of the direction in which research in radiation effects should proceed. It is a study of the living cell in artificial environments, but sufficiently indicative of the processes of development of tumor cells. An extension of this work, such as the observation of the effects of radiations upon isolated groups of cells, must yield valuable data for the investigation of this important subject.

Cultures of tumor cells could be subjected to doses of radiations and the changes noted. In this way it is probable that the question of wave-length and selective absorption would be solved. There does not appear to be any doubt that radiations of any wave-lengths, if given in the correct dose, will kill either tumor cells or normal tissue cells. In Drew's experiments on both forms of cell, the ultraviolet radiations kill in about ten minutes. It would be interesting to continue the investigations under similar conditions, using a progressive selection of radiations of shorter and shorter wave-length up to the gamma-ray of radium. The correct dose for each change of wave-length would be ascertained. If even experimentally it could be settled that it is possible to destroy particular cells by any wave-length of radiation, and if the dose of each wave-length for each specific cell could be ascertained, then it would in practical therapeutics become a question of which wave-length to employ in a particular case; as already stated, the selection of the wave-length would, in our opinion, largely depend upon the depth of the tissue from the surface of the body. These experiments would, it is believed, confirm the opinion expressed by a number of radiologists and physicists, that it is not always necessary [illegible] employ the most penetrating radiation to achieve success in the treatment of all forms of tumor cell, the determining factor in the selection being the difficulty of reaching a deeply seated tumor with the radiations of longer wave-length, rather than any selective action of a particular wave-length radiation upon a particular type of tumor. That this contention is correct is borne out by the clinical results obtained in a number of tumors of different types, in the writer's own experience, in favor of the use of radiations of medium penetration.

The question of the duration of the exposure is also of importance; it is not always necessary to give one large dose at one sitting in an endeavor to administer a lethal effect. The injurious effects upon the patient are a contraindication to such heroic treatment. Surely a method of treatment which may so severely damage the normal tissues that further treatment cannot be given for six or eight weeks is not only unnecessary, but entirely unscientific, and particularly undesirable if the *desired* effects can be induced by any other means.

In my own practice I have given very large doses spread over three or four weeks, in several instances amounting to forty hours in all. In a number of patients this line of treatment has given results quite comparable with those claimed for the lethal dose in one sitting. In radium-therapy, for instance, a most successful case of cervical carcinoma received a radium exposure lasting for seven days. The quantity of radium was small and used in needles buried in the growth. The patient was seen five years after the treatment, and she was absolutely free from the growth, and in perfect health.

My colleague, Mr. Cecil Rowntree, quotes a case of sarcoma of the cervical glands in which he left a small radium tube in the midst of the growth for twenty one days. The result was very striking, in that there was complete disappearance of the growth for a considerable time. An example of the success of the divided dose is seen in a case of a large secondary sarcoma of the left scapula; this was treated surgically, and radium tubes buried in the mass on ten occasions, with intervals of six weeks. The tumor has completely disappeared. This patient had an amputation of the right arm at the shoulder joint as long ago as five years.

The point I am stressing in radiation therapy is a plea for the use of common sense in the development of technique. Before a very large single dose is considered to be necessary for the cure or relief of the disease, surely it would be well to consider the natural processes of cure, and attempt to assist those processes rather than to emulate the surgeon, and knock out the growth at one blow. It is well to remember that there is one striking difference between the act of the surgeon and that of the radiologist. The former removes the tumor at one attack, there is a short period of shock, and a gradual recovery. In an attempt to do the same by radiation treatment, it is not possible to remove the tumor; it may be killed by one dose, but the tumor is not removed for some time; toxic effects are induced, and these may very seriously imperil life during the interval between the treatment and the disappearance of the tumor. From a practical point of view there can be no question of choice when a tumor is accessible—surgery is the better method.

The method of the smaller dose at frequent intervals is one which has had an extended trial, and by which results have been achieved. As a sequence to the observations of the method of the small dose given over a long period, it was also realized that if the total large dose could be divided and given at frequent intervals, and the action kept up for a considerable period of time, the result might be obtained with less risk to the patient, and, reasoning on physiological grounds, much more effectively. The object is to induce an action in the tissues, which will be beneficial, and because it acts as a stimulation of the reparative powers of the tissues in their fight against the invading cells, it is a more rational method than one which aims at a lethal effect upon the tumor at one sitting.

An effect of continuous action was hoped for by frequent small doses, administered daily, or every other day, or at longer intervals according to the effect observed. A large number of cases were treated by this technique; some patients received a dose of twenty to thirty or even forty hours' exposure, spread over several weeks or months. The results in a number of cases were very encouraging. Patients suffering from blood diseases, lymphadenoma, sarcoma and carcinoma were treated in this way. The idea was to keep up a continuous action by stimulating doses, by the administration of regularly intermittent doses. By the use of a technique of this kind, it was possible in a number of cases to get curative effects equal to or better than those claimed for the lethal dose at one sitting, with much less risk to the patient.

Dr. I. Seth Hirsch working on the same idea has subjected patients to continuous radiation for as many as fifty-six hours at one séance. He is evidently aiming at the same effect, but it is obvious that if the action can be kept up by the intermittent dose, it is preferable to the long dose at one exposure.

The underlying principle in the technique of Dr. Hirsch and that outlined in this article is the same, namely, that if the tumor cells are vulnerable at a particular phase of their life history, it is necessary to have the action of the rays acting on the tumor mass for a considerable period if we are to hope for success. If the effect can be induced by what might be called continuous biological reaction, as a result of repeated stimulation by regular doses at short intervals, instead of in one very long and obviously trying séance, then the frequent dose method is to be preferred. It does not matter whether the effect is produced by a lethal action on the tumor, or a stimulating one on the tissues. A technique of this order appears to be a nearer approach to the attainment of the natural cure of cancer described by Sampson Handley than the more strenuous one advocated by the believers in the lethal dose theory.

The great advance that has been made possible by the production of powerful apparatus and tubes capable of sustaining a high voltage current for long periods of time, enables us to use a very penetrating radiation in quantities sufficiently great to ensure the saturation of a tumor situated at any depth within the body. A technique which will allow of the utilization of such powerful radiations to the best advantage and with the minimum of risk has still to be found. It is obvious that great care must be exercised in the execution of the technique; our apparatus must be built on sound lines, and be capable of great accuracy of adjustment. The need for precision was recognized prior to 1915, when, at the Cancer Hospital, a method was evolved of which I wish to speak briefly.

DEVELOPMENT OF APPARATUS AND TECHNIQUE

Quite early in the development of radiation therapy in the treatment of cancer and other tumors and diseases it was realized that surely if slowly a rational method of treatment would be evolved from the purely empirical technique of the earlier days. Particularly in the so-called deep therapy was it felt that if the treatment was to be established on a sound foundation, a great deal of experimental work would have to be done. In England, for example, the need for precise methods of measurement was forced upon us, and quite early it was thought that the exact ionization method of the physicist must sooner or later become a clinical method. The many ports of entry paved the way for a more precise method of administering the rays, which was described in the Archives of Radiology in 1915.[17] In that paper the problem of deep therapy was entered into, and an apparatus described which would permit the administration of a dose of roentgen rays at practically any depth of the body. Observations of the action upon superficial lesions were utilized; it was observed that a little over a pastille dose on the skin had cleared up a case of superficial epithelioma, and it was assumed that if a similar dose could be administered at a certain depth, the same result would follow. In an endeavor to work out this problem, a considerable amount of experimental work was done with, for that time, a penetrating radiation through air and beef. An ingenious method of rotating the tube was worked out with the aid of Mr. C. E. S. Phillips and Mr. A. St. George Caulfeild. The tube, if set at an angle and rotated to describe a circle upon the skin, gave a beam of rays in the form of an inverted cone. The apex of the cone represents the crossing of the beam as it passes from the circle on the skin, and also represents the sum total of the converging beam. This can be recognized as the point of maximum intensity. It was calculated that with such a voltage as we then used, the time taken to give a little more than a pastille or erythema dose at a depth of four inches would be between three and four hours. Unfortunately the war effectually prevented any further developments of this technique. Quite recently the rotatory tube has been replaced by the rotating table, upon which the patient is moved slowly around. The effect is precisely the same, and this is the final development of this part of the technique. If it is considered desirable, a single large dose can be administered with absolute precision to any selected spot in the body. The apparatus and technique are described in an article by the author previously published elsewhere.[16]

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DISCUSSION

Dr. G. E. Richards, Toronto. It is a very great honor to be permitted to express my appreciation of the privilege of hearing a paper of this character by so eminent a visitor as Dr. Knox.

In the first place, I would like to say how great a pleasure it has been to hear Dr. Knox in this country, a pleasure which we have been looking forward to for many years. Last year, in company with Dr. Hickey and Dr. Crane, it was my privilege to visit Dr. Knox in his department and to see some of the work which he has described to us tonight.

It is not possible, nor would it be fitting for me to attempt to discuss Dr. Knox's paper. I want to exercise the privilege of youth to sit and listen to others who are competent to discuss the points which he has raised.

It does, however, seem possible that we can appreciate the points which he has raised as being logical, as being along the line of our own clinical observations in many of these cases. Even before the advent of the high-power, so-called, short-wave-therapy, we were occasionally observing the effects to which he has referred. The probability is that if our records had been developed along that line, great progress would have been made. The advent of possibilities of accurate measurement, the possession of radiation of a variety of wave-lengths, opened up an entirely new field, which we have pursued aggressively, but with many disappointments.

It now seems that the pendulum swings back again to the avenue of common sense, and along the line of nature's own hint to us in all her processes. The surgeon is the only privileged mortal who can entirely ignore nature's slow and gradual processes of repair and at a single stroke undo or remove what nature has been able to accomplish over a period of long months of effort.

If what Dr. Knox has indicated to us proves to be the line along which our work will find a satisfactory solution, then it does seem to make many of our problems more simple. One may even presume to regret that Dr. Knox has not entered into some of the practical problems of our every-day work. I venture to believe that radiation sickness in Dr. Knox's divided doses is not a problem. I think that a great many of us are finding a practical solution of the terrible difficulty of radiation sickness in a modification of the intensive method, and that we are practicing to some extent a modification of the teaching of some years ago. All of us have observed the fact that if we divide the dose over a number of shorter exposures, the sickness is reduced materially. I admit that I haven't had the courage to follow that to the logical conclusion and to adopt frankly a divided dose method of treatment. I shall go home from this meeting with renewed courage to do so, and to believe that by saving the patient the great inconvenience of the sickness caused by the intensive dose, we may still hope to obtain the type of result which compares very favorably with even the best that can be secured by the more intensive irradiation.

Mr. Chairman, you took me unawares, and all that I have to say is summed up in an expression of appreciation to Dr. Knox for this excellent and wonderful paper, and for the privilege and pleasure which it has been to be present and to hear Dr. Knox address us in this country and to renew the personal pleasure of his acquaintance.

Dr. A. C. Christie, Washington. I must say, with Dr. Richards, that it would be quite presumptuous on my part to attempt to discuss Dr. Knox's paper. It gives me very great pleasure to have the opportunity of thanking Dr. Knox for it, and to say how gratified we all are to have him here in this country with us. We have been hearing about him for a long time, reading his books and his papers, and have appreciated very greatly his work; it certainly is a great pleasure to all of us to meet him personally.

I think I will not attempt at all to speak of the work of Dr. Knox in this particular field. It does seem, however, that it opens up to us a new line of procedure that our own work has more or less been pointing out to us, especially the clinical results that we have been getting. The results obtained by those who have been using the new high voltage apparatus, but who have been giving divided doses certainly seem to indicate that just as much may be expected from this method as from the more radical one of the intensive dose, and this with much less immediate discomfort and danger to the patient.

I certainly shall not attempt to go further in discussing Dr. Knox's paper. I just wish to express again the great pleasure that it has been to me, personally, and I am sure to all of us in this Society, to have Dr. Knox here.

Dr. G. E. Pfahler, Philadelphia. I also feel quite certain that every one of us appreciates the great honor in hearing from Dr. Knox and to have him visit us and to permit us to shake his hand and to become better acquainted with him. We have been reading of his work and we believe that he is one of the greatest men in this line of work, not only in England, but in the world. Therefore, when he gives us a paper of this kind, we recognize that it is a review of the whole subject of radiotherapy in connection with the treatment of malignant disease. I think all of us who are in the neighborhood of Doctor Knox's age have had experiences very much like his. We all have seen patients get well of apparently hopeless conditions, malignant disease, from small, fractional doses of rather long wave-length, which in the light of these massive doses that we sometimes give today would certainly be considered stimulating doses, and yet they didn't stimulate, the patients got rid of the disease.

Now others have unquestionably gotten patients well with massive doses, and the results that both they and we have secured by the massive dose treatment have led to an unusual amount of enthusiasm. Therefore, we must conclude that there is also value in that line of treatment. Which is the better remains for us to prove, and I am not sure that we will prove it clinically. I am inclined to think that this very excellent work that is being done now by our skilful biologists in their interest in radiation may help to solve the problem.

We have before us the problem as to whether we will accomplish most by repeated doses, extended over a considerable time, or massive doses given in a short time. The new Coolidge tube is evidently designed with the thought that the greatest amount of radiation that can be put into the tumor tissue in the shortest period of time is the one that will produce the best results. That may be true. There is a theory at the basis of that that justifies such a procedure. We have all seen cases clinically that have responded for a short time, apparently brilliantly, and then they develop a resistance, and the more radiation you put on makes little difference, the disease goes right on and the patient dies.

The theory, then, that a massive dose, given at the very beginning, probably would have cured that patient has led to this development, and there may be, and probably is, some truth in that.

Other experiences would seem to indicate to the contrary. Professor Regaud, proceeds along the line of a long-continued, very minute dose, with the idea of killing the cells in their process of division. That is the theory of it, that you destroy the cells in process of division, and if you continue to destroy those cells in their process of division ultimately their destruction will be complete, because the older cells cannot reproduce and will finally die, and the tumor is cured. On that theory Professor Regaud now introduces, not a large quantity of radium into the tumor at one time, but very small quantities, and radium needles, not radium emanations, so as to get gamma radiation in small quantities distributed through the tumor over a long period of time. Last summer I saw him introduce into a cheek a series of needles. They had been in five days when I saw the case. Then he took out those needles and ran them in in the opposite direction, to get a cross-fire effect, and at the same time to secure a more prolonged action. There he is carrying out the theory of a prolonged, minute dose, over a long period of time, and is getting patients well.

The subject may also be approached from the experimental side. In one of these brilliant papers to which we have awarded prizes, Professor Mavor's paper, which is on a biological subject and which will help to solve some of these problems when the principles can be studied, there are presented the results of investigation of the physiological functions of the cells, not the cells microscopically, but in their minute function. He has watched the effects on the chromosomes of the cells, and I recall from reading the paper that he has secured the same effect, whether he used a large quantity of radiation at once or a small quantity over a long period of time. The results therefore are probably not so very different. The other problem that we have to solve, is the effect of radiation on the carcinoma tissue. Is it a destruction of the cancer cells themselves or is it some effect upon the surrounding tissue? And here again we have evidence on both sides, not only good arguments, but experimental evidence.

In the first place, the microscopic studies which show the granular degeneration, the vacuolation in cells, the progressive changes in the cancer cells, and the stimulation of the surrounding fibrous tissue which finally closes in, would lead us to think that probably the chief effect is the direct destruction of the cells.

On the other hand the brilliant work that is being done at the Rockefeller Institute seems to point to the opposite conclusion. I recall merely from memory that in one of the papers presented before the Cancer Research Meeting last winter, one of the experiments reported consisted in treating a number of mice before inoculation, with the tumors entirely absent, and the cancer inoculations in those cases failed to take, or a very small percentage of them were successful. There, of course, you have a strong argument that the cancer is killed and its growth prevented by the action on the surrounding tissue.

Now those are diametrically opposed theories, based upon diametrically opposed observations, yet they are both undoubtedly true, and sometime we will know the relative value of each. At the present time let us carry out the injunction that was given this morning in connection with Dr. Ullmann's paper, let us be physicians first of all, let us study our patients carefully from the clinical side, as to their natural physical condition, the extent of the disease as near as we can determine it both by our examinations and by our knowledge of pathology and the methods of extension, and then in the individual case adapt whatever of these methods seems best to suit that particular case. I think that that procedure is for the present clearly our line of action.

The next point in connection with this subject is to keep in mind the teachings of our own Dr. Bloodgood in teaching and helping the public to understand that the cure of cancer probably will depend upon the treatment and recognition of the conditions that lead to cancer, or of the conditions that precede cancer. If we can only teach the public to come to the physician, for treatment in the early stage, we will do much more than we will with all our most careful technique in the late stages.

Dr. Knox (closing). I don't think I need to say much more. I am entirely in agreement with What Dr. Pfahler has just said. There are arguments on both sides, and I tried to indicate the result of my own experience. I have seen the effects of very heavy radiation in carcinoma. I have given a limited number of very large doses, and it was the observation on the result of those massive doses that led us at the Cancer Hospital to modify our treatment in such a way that we could get the results without the upsetting effect.

I will refer to one case which I saw just before I came away. It was a case of mediastinal tumor, a sarcoma, quite a large tumor, in an elderly gentleman, and I was asked by the surgeon who sent the case to me to give a large dose. This I declined. I said I would use my own technique, and I tried the divided doses. Now I gave that man a relatively large dose but I took five days to give him three and a half hours. The first day I gave him one hour, followed up on the other side of the mediastinum with another hour, and then divided the doses by half hours. At the end of the fourth dose he complained of discomfort. I took the precaution of having his blood examined at once; his white cells had dropped down to 4,000, and I suspended treatment. Previous to coming to radiation treatment he had had a blood count made before an exploratory operation, done for the possible removal of the tumor. His white cells on the first count were normal, and I am perfectly certain that if I had given that man anything like six or eight hours, I should have killed him. As it turned out, his tumor disappeared. I saw him a day or two before I came away, and his mediastinum was perfectly normal. I don't expect it to remain like that, but I am perfectly satisfied that if I had been induced to give those massive doses, the patient would have died.

RADIUM AND ROENTGEN RAYS AS DIFFERENT AGENTS IN SUPERFICIAL AND DEEP THERAPY*

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WHETHER hard and soft roentgen rays and the gamma rays of radium produce the same or different biologic effects is a question which has been repeatedly raised. The same question has also been asked regarding the corpuscular alpha and beta rays, on the one hand, and the undulatory gamma and roentgen rays on the other.

The answer to this question depends to a great extent on the viewpoint taken. If the effect of the rays on tissue as a *whole* is considered, then there is no doubt that the action of soft roentgen rays is very different from that of hard roentgen rays. It is a well-known fact that some superficial diseases can be treated much better with soft than with hard roentgen rays, while others can be treated properly only with soft roentgen rays. As an illustration may be given the observation of Simpson that angiomas are very sensitive to beta and gamma rays so that they react even to very small doses, while they respond to hard roentgen rays only when very large doses are applied. Another example often cited to illustrate the different action of unfiltered and filtered roentgen rays is the observation that the range of dosage between the epilation dose and the erythema dose increases with increasing filtration. Recent observations have also shown that the skin metastases of breast carcinomas are influenced much less by heavily filtered than by lightly filtered roentgen rays. Finally, the question of which type of radiation is best suited to the treatment of carcinoma of the uterus, in particular, whether roentgen radiation or radium radiation, is asked again and again.

On the other hand, if we consider the effect on the molecule instead of on the tissue as a whole, we will get a different answer to the question of the action of rays of different wave-lengths.

It is the object of the present paper to make a small contribution from the science of physics to aid in clarifying this subject. In physics the action of rays of different wave-lengths is now well understood. For one thing we know that there is a tremendous difference between the action of rays of extremely long wave-length and those of very short wave-length.

We know that rays of long wave-length, such as visible light-rays, infra-red rays, and the electromagnetic waves used in diathermy, act on the molecule as a whole and produce molecular vibration, hence these rays produce only thermal effects.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

The action of rays of short wave-length, namely, ultraviolet, roentgen and radium rays is very different. The latter radiations primarily affect the atoms and their constituents, the electrons, and so produce chemical and dissociative effects.

The transition from thermal action to chemical and dissociative action as the wave-length decreases, is gradual. In the visible and the ultraviolet spectrum both effects are present. With hard roentgen rays and hard radium rays the dissociative effect is predominant while the direct thermal action is negligible. Although a small fraction of the primary energy is indirectly converted into heat by the recombination of part of the ions, the dissociative effect far outweighs the heat effect. This accounts for the marked toxic effect of rays of short wave-lengths.

It is therefore quite evident that the application of rays of long wave-length and of rays of short wave-length, no matter in what energy ratio, can never lead to the same biologic reaction. However, in a given range of wave-lengths, in the range of roentgen rays for example, approximately the same biologic effect can be produced if an element of tissue is rayed in the one case with hard rays and in the other with soft rays.

This assumption is made still more plausible by the following considerations:

The transformation of the energy does not take place instantaneously, but in stages. A part of the primary energy is scattered. According to recent measurements made by A. H. Compton, the wave-length of the scattered radiation is somewhat longer than that of the incident radiation. Furthermore, a large part of the primary and also of the scattered radiation is transformed into characteristic radiation, which is independent of the wave-length of the exciting radiation and depends only on the composition of the tissues in which it is excited. Finally, each one of these radiations causes electron emission (secondary beta rays). The velocity and the range of the emitted electrons depends on the wave-length of the exciting radiation. While the velocity and the range increase as the hardness of the primary radiation is increased, it must be noted that through the medium of the characteristic radiation a partial equalization takes place. The transformation of the energy of the rays into electronic energy also takes place in steps. The electrons, moreover, lose their velocity by successive collision and at each impact produce dissociation. The latter, therefore, cannot vary a great deal with rays of different wave-length. We may even go farther and say that there cannot be any fundamental difference between corpuscular and wave motion as regards biologic effect, since the wave motion acts only indirectly through the medium of secondary corpuscular radiation.

We are led to assume, therefore, that roentgen rays of different wave-length, gamma rays, and corpuscular beta rays, produce very similar effects on the cell from the standpoint of physics. Accordingly we may expect similar, if not exactly the same, biologic effects.

However, in the preceding consideration we have not yet taken into account the different *penetration* of the rays. The beta rays of radium are extremely soft and therefore nearly totally absorbed in the first few millimeters. Besides, due to the fact that extremely small focus skin distances are used, the intensity falls off very rapidly, also, in accordance with the inverse square law.

Although the gamma rays of radium are extremely penetrating, the distribution of intensity obtained with gamma rays is a great deal more un-homogeneous than that obtained with roentgen rays, since weak radium applicators are used at very small focus-skin distances, namely from 0 to 3 cm., while the roentgen rays are applied with focus skin distances from 30 to 50 cm. The following figures illustrate the intensity distributions obtained with various applicators used in practice.

Figure 1 illustrates the intensity or energy distribution for unfiltered roentgen rays.

Figure 2 illustrates the distribution of energy for a radium capsule, filtered by 1.5 mm. brass, if 1, 2 or 3 cm. focus skin distance is used.

Figure 3 is a chart, showing the distribution of roentgen-ray intensities for deep therapy conditions, indicated by the isodosage lines.

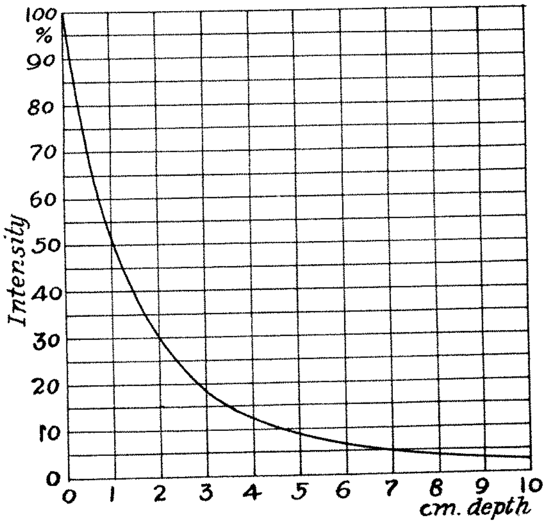

FIG. 1. Experimental intensity curves; 100 kv.; no filter; 20 cm. F.S.D ; small port of entry.

The intensity curves and the isodosage lines show that the intensity distribution in the interior varies enormously under different conditions. In some cases the energy is concentrated in a few millimeters, in others, the intensity decrease is very small. By the correct combination of several fields even a homogeneous irradiation of an extended region can be attained.

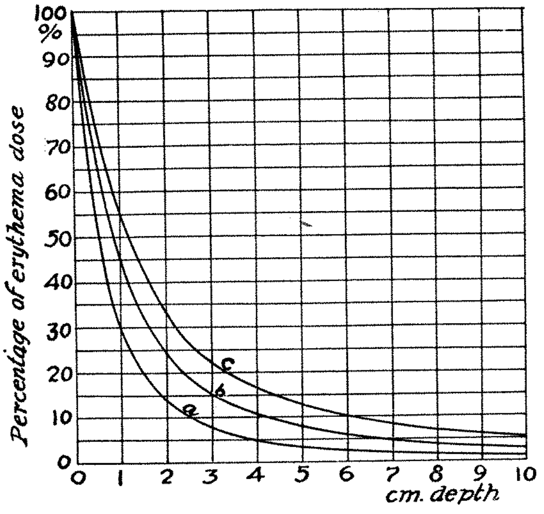

FIG. 2. Distribution curves of radium capsules in human tissue. 1.5 mm. brass filter; erythema dose designated by 100. (a) 1 cm. F.S.D., about 250–500 mgm. hrs.; (b) 2 cm. F.S.D., about 750–1500 mgm. hrs.; (c) 3 cm. F.S.D., about 1250–2500 mgm. hrs.

It is self-evident that these physical differences must assert themselves biologically. The difference in biologic reaction in many cases is so prominent that it cannot escape observation. The best known example is the action of hard and soft roentgen rays. According to Dessauer, hard roentgen rays bear the same relation to soft roentgen rays that an extremely dilute drug does to a highly concentrated one. This is true, not because, as Dessauer assumes, that they are two different medicaments, but because they represent different space distributions. Hard rays can be applied only in small densities on account of their extended distribution, while soft rays can be applied in much greater concentrations on account of their localized action.

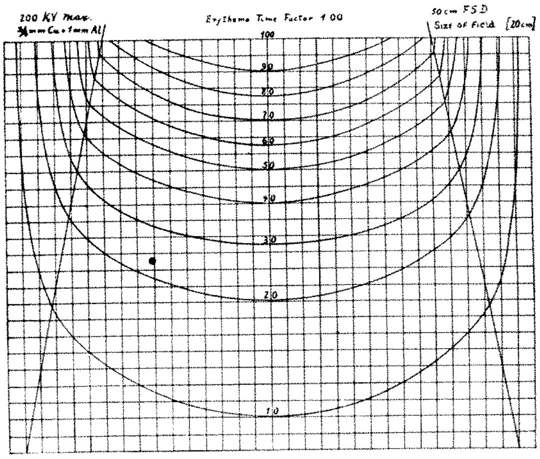

FIG. 3. Roentgen-ray distribution chart.

The examples cited at the beginning of this article may all be explained on the basis of the different distribution of hard and soft rays.

The angiomata mentioned by Simpson are enlarged blood vessels in the outer layers of tissue. It is evident that they are best treated with less penetrating rays. For the same reason an epilation can be carried out better with soft rays than with hard rays, since the hair follicles are at the depth of a few millimeters. Skin metastases can be treated better with soft rays, because with the latter a large dose can be applied locally to the surface without damaging the underlying tissue.

These phenomena do not in the least prove that hard and soft rays are different medicaments, but rather show that the same medicament is applied in different concentrations. A most striking experiment in support of this view is one performed by Gudzent, who compared the alpha radiation of thorium x with extremely penetrating roentgen radiation. The same distribution was obtained in the two cases by applying the roentgen rays homogeneously and distributing the substance giving out the alpha rays uniformly through the body by means of injections. The biologic effects in the two cases were exactly alike.

With these ideas it becomes a simple matter to answer the following questions:

(*a*) Why do diathermic rays and hard roentgen rays produce different biologic effects?

Although the absorption and the distribution is approximately the same for the two types of rays, their physical action is very unlike; diathermic rays affect the molecule as a whole and therefore produce heating; roentgen rays cause dissociation of the atoms and therefore change the structure of the atoms and molecules.

(*b*) Why do hard and soft roentgen rays produce biologic effects?

While the action on the atomic constituents of the cells is approximately the same, the softer rays are more easily absorbed and therefore produce a much stronger local action than do the hard rays.

(*c*) Why do lightly filtered roentgen rays and hard radium rays produce the same biologic effect?

Although the hardness is very unlike, the distribution resulting from absorption and distance is similar in both cases, so that a strongly localized superficial action predominates over the action at a depth.

(*d*) Why is the biologic action of very soft roentgen rays similar to that of the beta rays of radium?

Although we are dealing with a wave motion on the one hand, and a corpuscular motion on the other, still within the tissues both types of rays produce ions and therefore have a dissociative effect. The distribution produced by absorption and distance is also similar in that it is very un-homogeneous. This accounts for the local effect of these two types of rays.

As a summary we may state the following general principle:

The biologic dissimilarity of rays which occupy very different positions in the scale of wave-lengths is due chiefly to their different physical or chemical (dissociative) action. The biologic dissimilarity of rays which occupy positions close together in the scale of wave-lengths is due to their different distribution in the interior of the medium, irrespective of whether the actual distribution is the result of absorption or of distance.

On the theory that all roentgen rays and radium rays represent the same medicament, but that the distribution of this medicament varies under different conditions of application, we can draw the following conclusion with regard to practical dosage:

When it is required to irradiate large regions fairly uniformly, roentgen rays are to be preferred. Radium, even under the most favorable circumstances, does not afford so homogeneous a distribution as can be attained with roentgen rays under ordinary conditions. For this reason roentgen rays should be used in the treatment of extended glandular regions, as well as in cases in which an effective action is desired at a depth, unless the region to be irradiated is accessible for radium treatment.

I would not go into this subject in such great detail except for the fact that a large number of incorrect treatment methods have come to my personal attention.

One of the first patients I saw in America had carcinoma of the rectum. The patient had been treated with a radium capsule placed on the abdominal wall, and not even an erythema had been produced. It was only after he had been treated with hard roentgen radiation that an erythema was produced in the area previously treated.

In another case I read a letter in which it was recommended to treat carcinoma of the uterus by means of radium cross fire. I was consulted in time to prevent the carrying out of this plan. According to my calculations, the seat of the carcinoma would not have received more than 5 per cent of an erythema dose under those conditions.

A third case of an incorrect treatment method came to my attention a month ago. The inguinal glands had been treated by placing a radium capsule directly on the skin. In this way, a strong erythema had been given so that a correct treatment with roentgen rays was no longer possible.

Equally as erroneous is the other extreme of treating with roentgen rays a deep-seated tumor which requires a strong local irradiation.

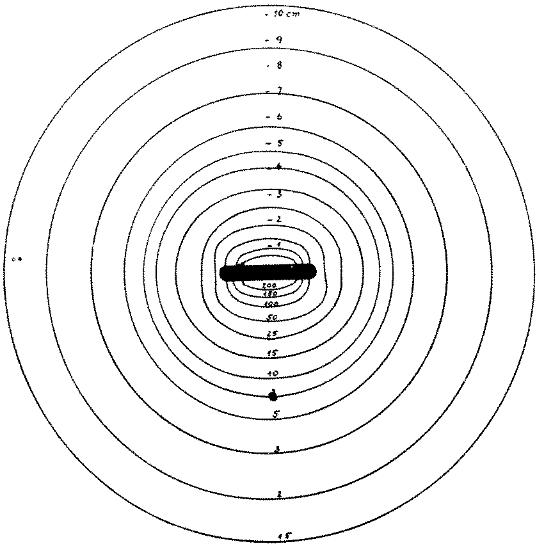

Fig. 4. Distribution chart of radium capsule, surrounded by tissue. 1.5 mm. brass filtration, 500–1000 mgm. hrs. applied; erythema dose designated by 100.

Growths of the columnar cell type, in the cervix for example, or of the squamous cell type in cases of carcinoma of the tongue, can not be treated successfully with roentgen rays. In these cases the strong local action afforded by radium must be used and a greater dose must be applied than could safely be given with roentgen rays.

A combination of roentgen ray and radium treatments is desirable in many cases, particularly those where, in addition to a strong localized irradiation of a tumor, a less intense but uniform irradiation of the surrounding tissues is required.

A method for adding roentgen ray and radium energies numerically was developed by the author in 1920. In combined radium and roentgen-ray treatment it is often desirable to know the number of milligram-hours equivalent to a given number of milliampere minutes—the word "equivalent" being used in the sense that the two produce the same skin reaction. By assigning the value 100 to the dose which produces the same skin reaction with various types of rays, a unit is determined which enables both the biological comparison and the numerical addition of different kinds of rays.

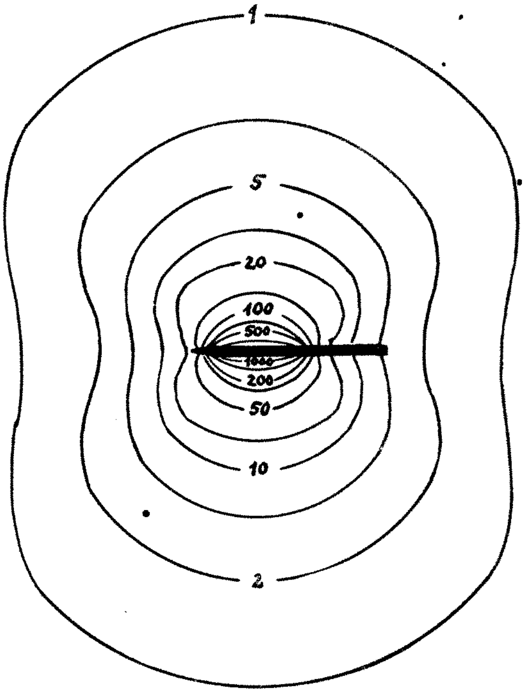

Fig. 5. Distribution chart of radium needle, surrounded by tissue, 50–100 mgm. hrs. applied. Erythema dose designated by 100.

The values for radium rays given by the author at that time (1920) referred to the strong erythema *then* widely used in Germany. Since then Failla and his coworkers have published extremely valuable tables, which enable a biological comparison in terms of the so-called "average erythema." Failla's values refer to a very weak biological reaction and are roughly half of the values published by the author.

Most of the doses actually used in practice are about midway between these two.

The best method of adding roentgen ray and radium energies consists in drawing the isodosage lines as suggested by Glasser. A few such charts are sufficient for most practical purposes.

Figure 4 indicates the isodoses of a radium capsule. The isodose 100 represents the energy which produces an erythema if 500 to 1000 mgm. hrs. are applied.

Figure 5 shows the energy distribution of a radium needle measured by the same biologic unit.

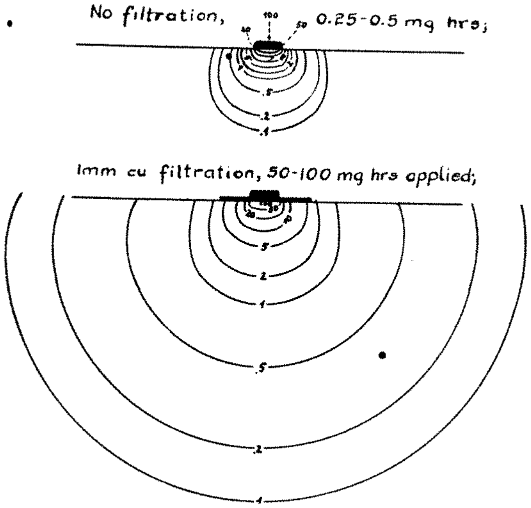

Fig. 6. Distribution chart of radium plaque; erythema dose designated by 100.

Figure 6 gives the isodoses for surface applicators in the same scale.

The values obtained with roentgen rays are taken from charts similar to those originally prepared by Dessauer. Charts for the treatment factors used in this country have been prepared by the author, by Glasser, and by Erskine. The values obtained are in close agreement.

Figure 7 shows one of the charts constructed by the author. Besides giving the distribution in both the directly rayed and the indirectly rayed regions, it shows how the distribution depends on the thickness of the patient. It has been found that the intensity at a point in a surface of emergence is one-fifth less than it would be if additional tissue were present. The author's charts have been prepared from measurements made with a large water-phantom. If any point of the chart lies in a surface of emergence, then one-fifth of the intensity given by the chart must be subtracted in order to obtain the actual intensity at that point.

The tables also give the time required with various fields to produce the same biologic reaction. If the erythema time for a large field, namely 20 cm. × 20 cm., is known, then the erythema time factor given on the chart enables the determination of the erythema time for the field in question.

The energy which produces an erythema of the skin may again be designated by 100.

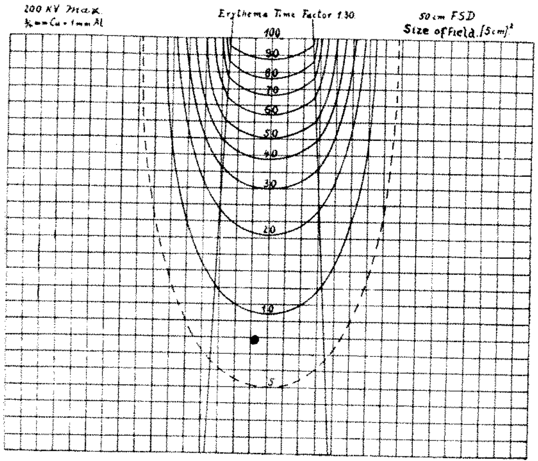

Fig. 7. Roentgen-ray distribution chart.

By the use of the above-mentioned charts the distribution of the roentgen ray and the radium energy can be determined in terms of the same biologic unit. The numerical addition of the two energies gives the total effect of the combined roentgen ray and radium treatment for any point in question.

DISCUSSION

Dr. A. H. Pirie, Montreal. I would like to ask Dr. Bachem one question. He stated the difference in the dose with soft and hard rays. Now we have all got epilation with soft rays, and with those that are using 200,000 volts and ¾ mm. of copper they get epilation just exactly the same way. As far as I see the soft and hard rays are the same. I would like to have the doctor explain what difference he makes out.

Dr. Bachem (closing). In reference to epilation, I would say this: We know that with really soft rays it takes nearly an erythema dose to produce proper epilation. However, if we filter the rays there is a certain range between an epilation dose and an erythema dose. The harder the rays the more difference between the doses. The explanation can be easily given by the fact that in producing an erythema we produce a superficial effect. In producing an epilation we have to treat a depth of a few millimeters. With very soft rays we cannot treat the depth of a few millimeters with such a strong dose as is necessary to produce epilation. With better filtered rays we can control more accurately the dose to the part.

About measuring the proper depth dose, I gave the proper conditions about one year ago at the meeting in St. Louis, and that has been published in the *Radiological Journal.* The most important thing in this is that we use an instrument which measures the total amount of scattered and secondary rays. It is a physical question whether or not an ionization chamber measures the full amount of these rays, and our opinion is this, that a very small chamber, let us say, like the chamber of Friedrich, measures the full amount. If the chamber is too large, or is filtered too heavily by aluminum, it would not measure the full amount of scattered radiation. The measuring instrument may be a little tube filled with a photographic emulsion, it may be a photographic film, it may be a small ionization chamber. We measure the full scattered radiation as well in the depth, as on the surface. In this case we can be quite sure that we measure the proper depth distribution.

THE NEW TYPE OF HIGH-VOLTAGE ROENTGEN THERAPY IN THE TREATMENT OF CARCINOMA OF THE BLADDER*

BY CHARLES A. WATERS, M.D.

BALTIMORE, MARYLAND

WITH the introduction of the cystoscope came the first successful efforts in the handling of bladder tumors, mainly on account of the increased possibilities of earlier diagnosis, which enabled surgeons to devise methods for their removal.

The results from surgery were discouraging. However, in fully 50 per cent of the cases, the tumor could be successfully removed or destroyed by operative procedures (Fig. 1); but it was soon discovered that bladder tumors had an extremely marked tendency to recur, not at the site of removal but in other parts of the bladder. Repeated suprapubic operations were out of the question, and furthermore, the trauma resulting from the operation frequently changed relatively benign tumors to extremely malignant ones.

The introduction by Beer of fulguration in 1910 showed that the so-called benign and malignant papillomata could be successfully handled by this intravesical method of treatment with results much superior to any surgical procedure (Fig. 2).

It has been our experience that 40 to 50 per cent of all tumors appearing in the urological clinic belong to the papillomatous group. It was soon found that while fulguration was so successful in the handling of papillomata it was worse than useless in the treatment of papillary carcinoma, either superficial or infiltrating.

With the introduction of radium, experience has shown that the superficial papillary carcinomas, which comprise 15 per cent of the bladder tumors seen, could be handled by radiation, the radium being applied intravesically to the surface of the tumor (Fig. 3). No results are to be obtained by this method of radiation when the tumor is deeply or extensively infiltrating (Fig. 4).

When the superficial or non-infiltrating papillary carcinoma covers a large extent of bladder area (Fig. 5), endovesical radium treatment is quite unsatisfactory, owing to the extent of the area to be radiated.

It has been the experience in our urological clinic that 10 per cent of the infiltrating carcinomas are sufficiently localized, or occupy positions where radical resection can be carried out, as shown in Figure 1. On the other hand a tumor may be comparatively small but located on the trigone and involving the posterior vesical orifice in such a way that radical excision with any hope of success means the necessity of transplanting both ureters, removing the posterior portion of the prostate and excising the trigone, a procedure technically difficult and rarely justifiable (Fig. 6).

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

With the combination of fulguration and radium applied to the surface of the tumor through the urethra and a suprapubic excision of extensive papillary carcinoma by the cautery the maximum possibility is 75 per cent of tumors which stand any chance of being cured.

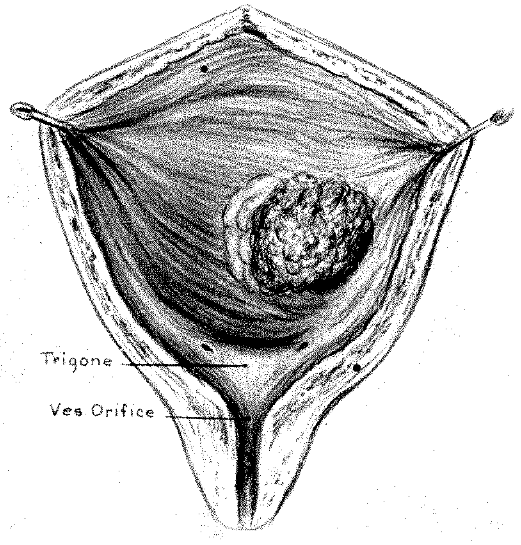

Fig. 1. A large papillary carcinoma of the bladder which is infiltrating, as shown by the edema along the inner margin. This case represents the infiltrating type which is resectable.

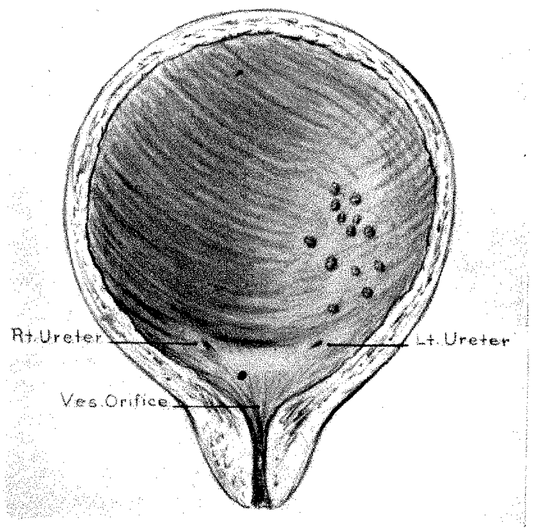

Fig. 2. Papillomata, which, when not too extensive, can be cured by fulguration. This particular case was partly relieved by deep roentgen therapy.

This leaves about 25 per cent of tumors occupying positions which render them inoperable or involving such extensive areas of the bladder that surgery or endovesical radium treatment offers no chance of success (Fig. 7).

The development of radium therapy has demonstrated that in a certain percentage of these hopelessly infiltrating cancers, opening the bladder suprapubically and implanting the tumor area with either emanations or the radium element will result in the destruction or elimination of the tumor.

In a series of approximately 30 hopelessly inoperable cases, radium implanted in the tumor has resulted in a cure in about 25 to 30 per cent so far as the removal of the tumor is concerned.

A warning should be given in regard to the amount of radiation that can be used in these cases. Seldom should one exceed 2500 to 3000 mg. hrs.

Recently, because of the tremendous sloughs in deep radium burns produced by the bare radium emanation tubes, we have been employing small radium element needles thoroughly screened by platinum, filters which screen out at least 95 per cent of the beta rays.

The case in which this method of implantation has been employed has given equally as satisfactory results so far as the emanation is concerned, and with the minimum burn and irritation. One can see by the statistics quoted that there still remains a large number of cases unsuitable for fulguration and endovesical radium treatment and too extensive for resection or the employment of radium needles, and in which some further therapeutic agent is needed.

It is here that deep roentgen therapy with its modern and improved methods of application seems to offer help. Of course it is too early to attempt to draw any

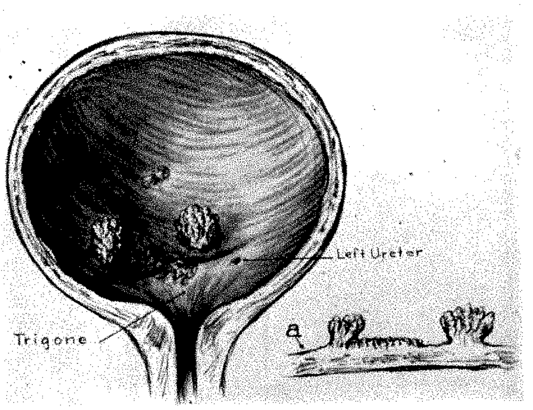

Fig. 3. This case shows the type of papillary carcinoma which is creeping along the surface of the mucosa of the bladder and in which radium alone will effect a cure.

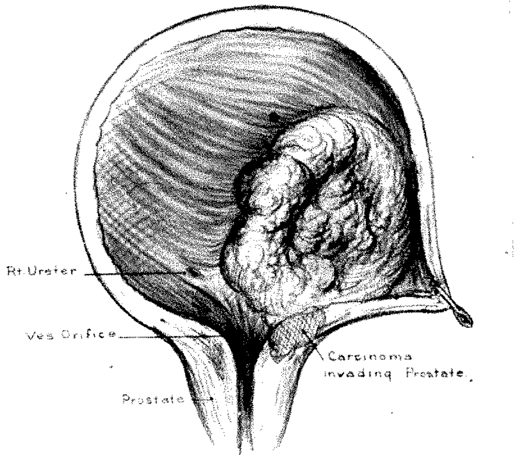

Fig. 4. A very extensive inoperable deep infiltrating carcinoma of the bladder. This patient was given, in August, 1922, a dose of 120 per cent roentgen rays into the tumor with no effect on the growth. Six months later another series of deep roentgen treatments amounting to 120 per cent failed to destroy the tumor. Two months later an incomplete series of deep roentgen treatments, amounting approximately to one-half a full cancer dose, was given and at the same time radium needles were implanted in the tumor through a suprapubic opening into the bladder. The tumor rapidly and completely disappeared in six weeks as found cystoscopically. There has been no recurrence of the tumor in six months. This case represents the type of bladder cancer which has been considered hopeless. The combination of radium and deep roentgen therapy at the same time seems to offer possibilities in cases which heretofore have been looked upon as hopeless.

absolute conclusions regarding the position that deep roentgen therapy is likely to attain in the treatment of bladder tumors.

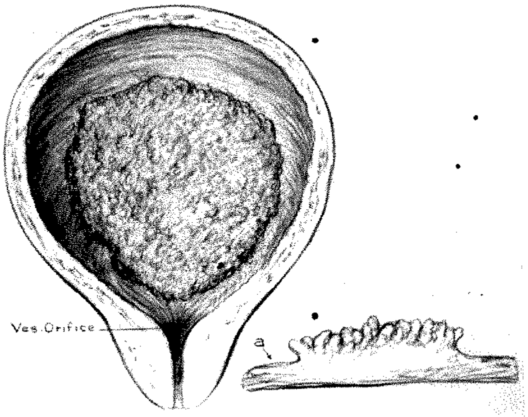

Fig. 5. A large type of papillary carcinoma of the bladder, completely destroyed by a dose of 125 per cent deep roentgen rays to the posterior bladder wall.

This much can be said positively, however, that it has a very definite beneficial and specific influence on certain types of carcinomas of the bladder.

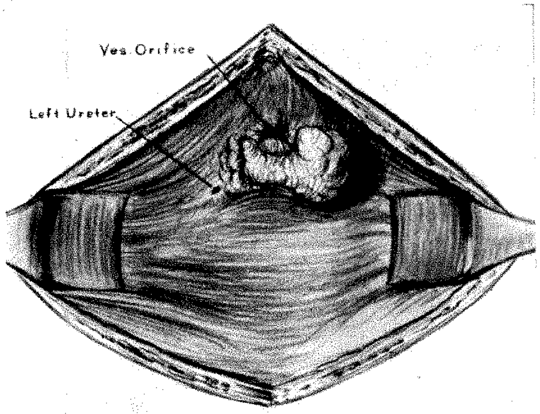

Fig. 6. This is the type of tumor which has heretofore resisted all forms of treatment. It is not resectable on account of its location, and radium in sufficient quantities to destroy the tumor causes so much edema and irritation of the bladder as to produce obstruction. It can be benefited by local applications of radium along with a dose of 130 per cent roentgen ray to the tumor.

Experience will probably show that it has a marked influence on the multiple superficial papillary carcinomas which dis-

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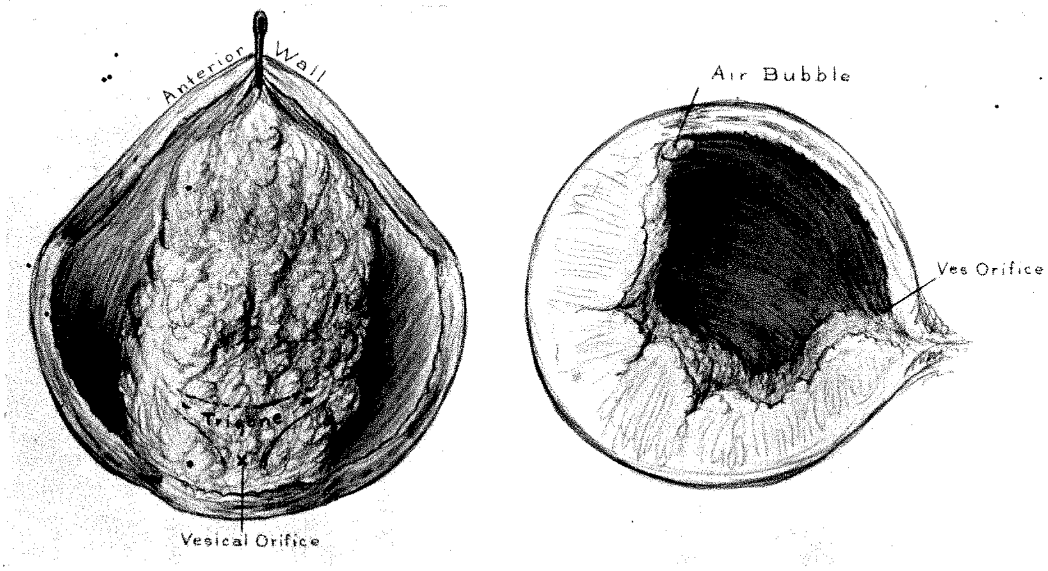

FIG. 7. This case shows a large inoperable carcinoma of the bladder, which is too extensive for surgery or radium. The only possible hope of doing anything is with deep roentgen therapy.

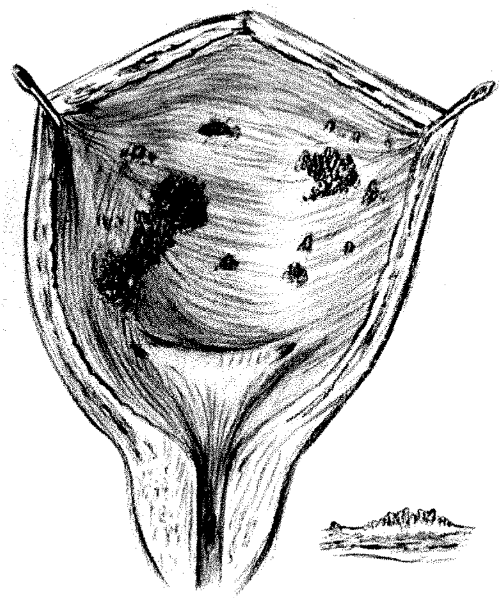

FIG. 8. Multiple carcinomata of the bladder which can be destroyed by radium but which recur almost as fast as they are destroyed. On account of the widespread involvement of the bladder by these tumors, intravesical radium treatments are unsatisfactory, due to the great amount of irritation produced by the radium. It is in this type of case that deep roentgen therapy has in a few instances offered brilliant results.

appear under radium but recur almost as fast as they are removed (Fig. 8). Furthermore, I think we can predict with safety that in certain types of tumors, a combination of radium and deep roentgen therapy will cause the disappearance of tumors which neither method alone would effectively handle, as shown in Figure 4.

In the cases treated successfully by deep roentgen therapy there is apparently none of the burn and slough which follows radium except when the latter is very carefully employed.

During the past eighteen months we have been employing deep roentgen therapy in a large number of all types of bladder cancer. A small group of cases have received roentgen rays alone while in the majority of the cases they have been employed along with other standard methods of treating this condition; and it is the belief of our urologists that deep roentgen therapy will occupy a definite position in the treatment of bladder tumors.

It has been our experience that deep roentgen therapy will cure a certain percentage of bladder carcinomas which are unsuitable for other forms of treatment.

One can readily see, from what has just been said, the necessity for the urologist and roentgenologist working hand in hand because successful treatment depends upon accuracy in diagnosis.

It might be said in conclusion that the pathological study of bladder tumors has helped very little in the successful treatment of them. In our clinic we have learned that the information secured by the skilled cystoscopist plus the information and experience gained by the use of these different methods of treatment, make possible the successful treatment and ultimate cures of bladder carcinomas which were until recently looked upon as hopeless.

THE RESULTS OBTAINED AFTER TWO YEARS' APPLICATION OF DEEP ROENTGEN THERAPY IN CASES OF CANCER OF THE PROSTATE AND BLADDER*

BY CARLOS HEUSER, M.D.

BUENOS AIRES, ARGENTINA

CASES of cancer of the bladder or prostate are very common in Buenos Aires. Every specialist in urinary diseases sees several cases annually.

The cases that came under our treatment had been operated upon before they received deep roentgen treatment. In all these cases the pathological examination of the tumor was made and the diagnosis was cancer.

In another part we will discuss cases of prostatic tumors (adenoma) which we have treated with roentgen therapy because, on account of an excess of urea in the blood, they could not be operated upon.

In 6 cases of cancer of the bladder, 5 have continued to do well during two years, without evidence of any return of the cancer. The sixth case died on the first day after application of the roentgenotherapy because of the great extension of the cancerous growth in the rectum. Out of the 5 cases 1 still has blood in the urine, and the other 4 are doing well.

I will not occupy your time with details, but will state the facts of each case in a few words.

CASE I. Male, aged fifty-five. Complaint, pain in the bladder, passing blood and pus for five months. After several treatments a tumor was found and operated upon. The operation revealed a tumor which was too large to be removed. The diagnosis according to the pathological preparation made from a specimen taken for that purpose, was cancer. One month later roentgen-ray treatment was applied, and four months after the application neither blood nor pus could be detected in the urine.

Eight months after the deep-roentgen treatment, a hard tissue appeared on the walls of the abdomen and a roentgen ulcer formed. There was also keratosis in the region of the sacrum and in part of the perineum. During the last six months these ulcerations have been healing slowly.

CASE II. Male, aged sixty-two. He had been operated upon for a large tumor in the bladder, which it was impossible to remove. Deep roentgen treatment was applied.

One year after this treatment roentgen ulcers had formed on the right and left side of the femur which discharged for six months causing great pain, burning and general debility.

Now, six months afterwards, the ulceration is healing slowly. No blood is noticeable in the urine and the tumor is reduced. A hard fibrous tumor can be observed on the perineum.

CASE III. Male, aged eighty. Confined continuously in bed. He passed a great deal of blood and pus in the urine. He could not retain urine and needed continuous catheterization. He was operated upon; the tumor, however, was not removed—only a small part was taken out for anatomical pathological preparation.

Deep roentgen treatment was commenced five days afterwards. Eight months after the latter treatment a big roentgen ulcer in the suprapubic region had developed and another over the right condyle of the femur. The bladder was sound, and the urine clear without blood or pus. He had no pain and could retain about four ounces of urine.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

CASE IV. Male, aged forty. He was operated upon for cancer, and after operation deep roentgen treatment was given.

One year afterwards he showed a large roentgen ulcer on the stomach in the suprapubic region and also one on the perineum. For eight months after the deep roentgen treatment he passed blood, but at present this has disappeared and the ulcers are healing. He also suffered for about two months with diarrhea as a result of the application.

CASE V. Female, aged fifty-five. Suffering from a large tumor in the bladder that caused great pain in urinating, also passing blood and pus. A part of the tumor was removed with the aid of the cystoscope and, an anatomical pathological preparation having been made, the diagnosis was cancer composed of small cells.

Deep roentgen treatment was made from front, back and each side, and also from the perineal region by means of my specially constructed chair for deep roentgen treatment.

One year after this application the patient complained of the formation of a roentgen ulcer on the vulva and in the suprapubic region. At the time of writing this paper she has improved greatly; neither pus nor blood occur in the urine, and she is on the way to recovery.

In this connection I would like to state that my specially constructed chair greatly facilitates the application of deep roentgen treatment to the perineal region and also to diseases of the vulva and anus. With the chair five different regions can be exposed to the roentgen treatment. It is to be recommended that the patient should bend forward in a sitting position so that the rays have a better action on the tumor, not, however, because he would be in a better position for exposure, but because he will remain quiet.

While I would not base a definite opinion of the efficacy of this treatment in general, on a few cases such as these I may state that the results obtained have been highly satisfactory, especially where surgical operations have been valueless.

DISCUSSION[1]

DR. GOOSMANN, Cincinnati. I had the privilege of reading a paper on the subject of tumor of the bladder at the Louisville meeting of the Middle Section. That paper will be published shortly in the Journal. We had 15 cases in the first year of high voltage *x*-ray treatment. Of the 15 cases, in 9 we had a primary recovery. That is, the cystoscopic examination showed no evidence of the tumor after treatment. We had no *x*-ray ulcers.

The last case included in that report was treated, I think, in November, 1922. I am not anticipating any ulcers, but I assure you that if I have them, I am going to change my technique.

DR. D. Y. KEITH, Louisville. The first case reported by Dr. Waters is very interesting from the standpoint of filtration. He did not mention the screen used in his first radium application, but it is evident that silver filtration was used.

This patient received an application of radium inside the bladder through a cystoscope and a series of deep roentgen-ray treatments, followed a few weeks later with a similar series of deep therapy, using copper filtration, with no response. He came back showing no improvement, and by the implantation of needles, in which the filtration was very little, if any, the tumor receiving alpha, beta and gamma rays, entirely disappeared. From our personal experience we believe the future of the treatment of neoplasms will be in using the proper filtration, as well as the proper voltage.

About two and one-half years ago, when we first began to use ½ mm. of copper filtration with 110 kv., a blonde patient with a recurrence of a breast malignancy along the line of incision with metastasis in the axilla, received a maximum dose, with copper filtration, from the posterior field of entry and a similar dose from the anterior field. In one of these treatments thirty minutes was given using only one piece of photographic glass and ½ mm. of aluminum at a 14 in. anode skin distance; this, of course, occurred by accident, as the filters were left out. Much to our surprise the reaction was not so marked as we had expected. The recurrent nodules in the skin and the axillary metastasis entirely disappeared. The patient is alive and free from recurrence today.

Since this experience we experimented with our superficial malignancies about the nose and face, using different filters during *x*-ray and radium exposures, and we are firmly convinced that complete regression from this type of radiation is much quicker than with any other filtration used. If anyone here has been using filtration of this type, we would be glad to hear from them. If not, we would like some of you who are interested to try this method of treatment and report at a later meeting.

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[1] This discussion has reference to the preceding paper by Dr. Waters, as well as to the above.

Dr. Waters (closing). There is little I can add in closing. There are so many phases to the treatment of carcinoma of the bladder, namely, the type of tumor, its size, location, and so forth, that I have only tried briefly to bring to your attention what has already been done generally and to indicate the aid one might hope to expect in the relief of this condition by the employment of deep *x*-ray therapy.

The question of the use of fractional versus the large massive doses offers an interesting subject. I have used only the open tube stand and it has been impossible for me to give treatments longer than forty-five minutes on account of the apparently increased absorption of scattered radiation. If the longer massive doses are used I feel sure that your patients will get so much absorption that they will never recover from the severe prostration.

I believe the occurrence of an aplastic anemia by using the open tube stand is a much more likely and serious complication than with the closed stand. In order to get 130 per cent into the bladder tumor we find that almost always the white blood count comes down to from 3,500 to 4,000, and many of these cases start with comparatively low white blood counts and of course their reduction is in proportion. If you do not make blood counts every few days, you are bound to get these aplastic anemias and apparently nothing will cause the blood to regenerate.

HYDRONEPHROSIS*

BY BERNARD H. NICHOLS, M.D.

CLEVELAND, OHIO

In our clinic a study of the histories of cases of hydronephrosis shows that in more than 30 per cent a previous operation had been performed for cholelithiasis or appendicitis without subsequent relief of the symptoms. Such a simulation of symptoms in appendicitis, gall-bladder disease and right-sided hydronephrosis indicates clearly the importance of pyelography in the determination of the differential diagnosis.

Cabot pointed out in 1913 that in many cases a pyelogram of the suspected kidney is the only means by which an early hydronephrosis can be diagnosed. If this is true of early hydronephrosis it is evident that the diagnosis of the later stages of the disease can easily be confirmed by the same method.

Hydronephrosis is a retention of urine in the kidney pelvis due to obstruction either in the kidney or in the ureter, with a resulting dilatation of the calyces and kidney pelvis followed by atrophy of the kidney cortex. Occasionally also stones in a calyx or stricture of the infundibulum may produce a localized hydronephrosis of one calyx (Fig. 7). This brief statement regarding the nature of the condition suggests that before discussing the interpretation of the roentgenological finding, it will be well to consider briefly the structure and normal anatomical supports of the kidney and ureter. The principal divisions of the kidney are the cortex and the pelvis with its major and minor calyces. The pelvis is pyramid-shaped like a funnel with its apex toward the uretero-pelvic junction; at its base, the pelvis divides into the major calyces, which are usually three in number—upper, middle and lower. The major calyces in turn are somewhat pyramidal in shape with their bases toward the periphery of the kidney, and in turn are subdivided into the minor calyces.

In different individuals the kidney pelvis may vary greatly in shape and size. Its shape may be comparatively spherical (Fig. 1 B), square (Fig. 2 D), long or tubular (Fig. 1 C). The major calyces may unite so as to form its greater portion (Fig. 2 A), or the major calyces may be practically absent so that the pelvis leads directly into the minor calyces (Fig. 2 D). The capacity of the pelvis is usually greater than that of the calyces combined (Fig. 1 B) although in some cases it may be much smaller (Fig. 2 A). If the pelvis is large,

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* Read at the Twenty-fourth Annual Meeting of The American Roentgen Ray Society, Chicago, Ill., Sept. 18–21, 1923.

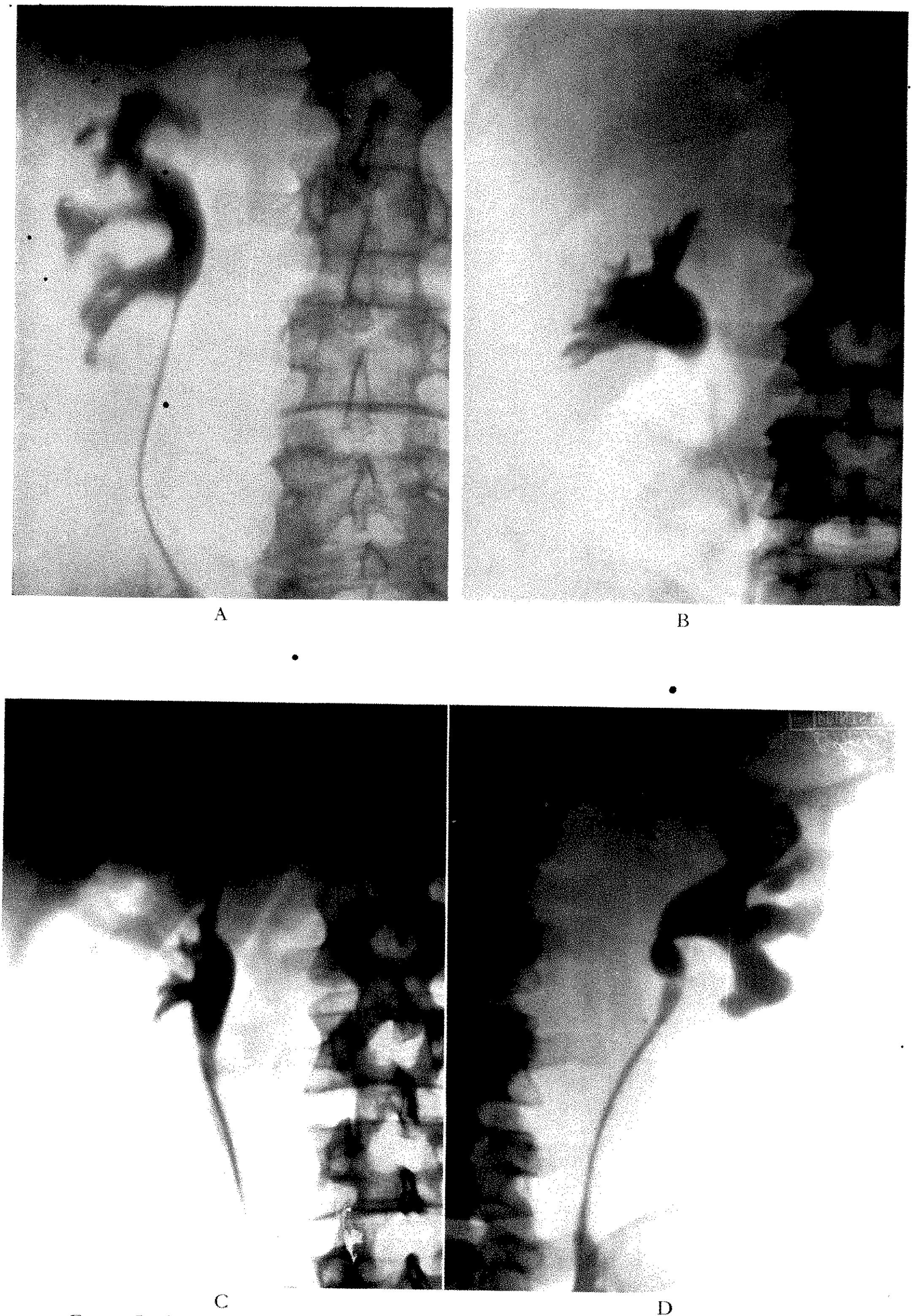
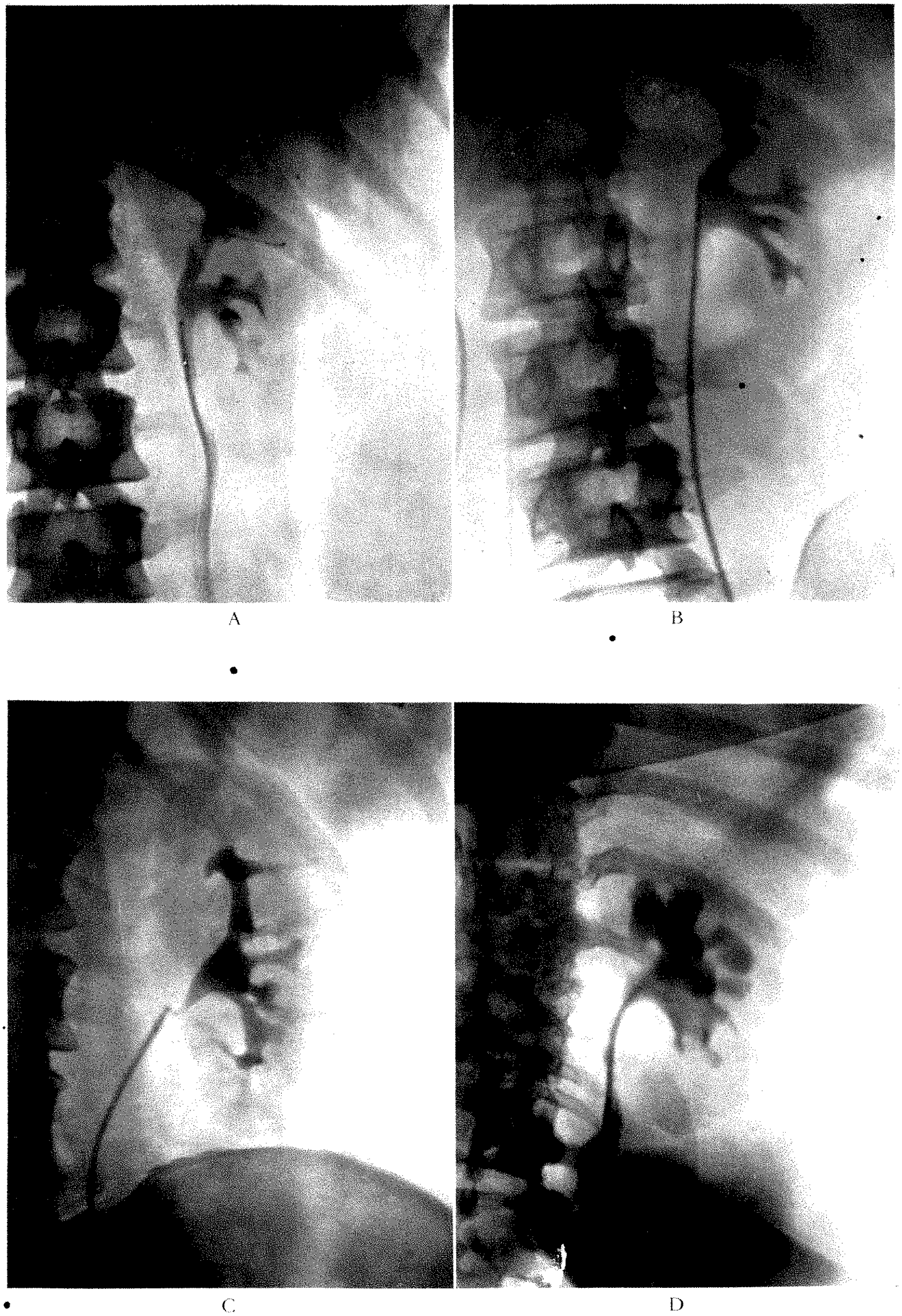


Fig. 1. Pyelograms showing variations in the shape and size of the normal kidney pelvis.



A B C D

Fig. 2. Pyelograms showing variations in the shape and size of the normal kidney pelvis.

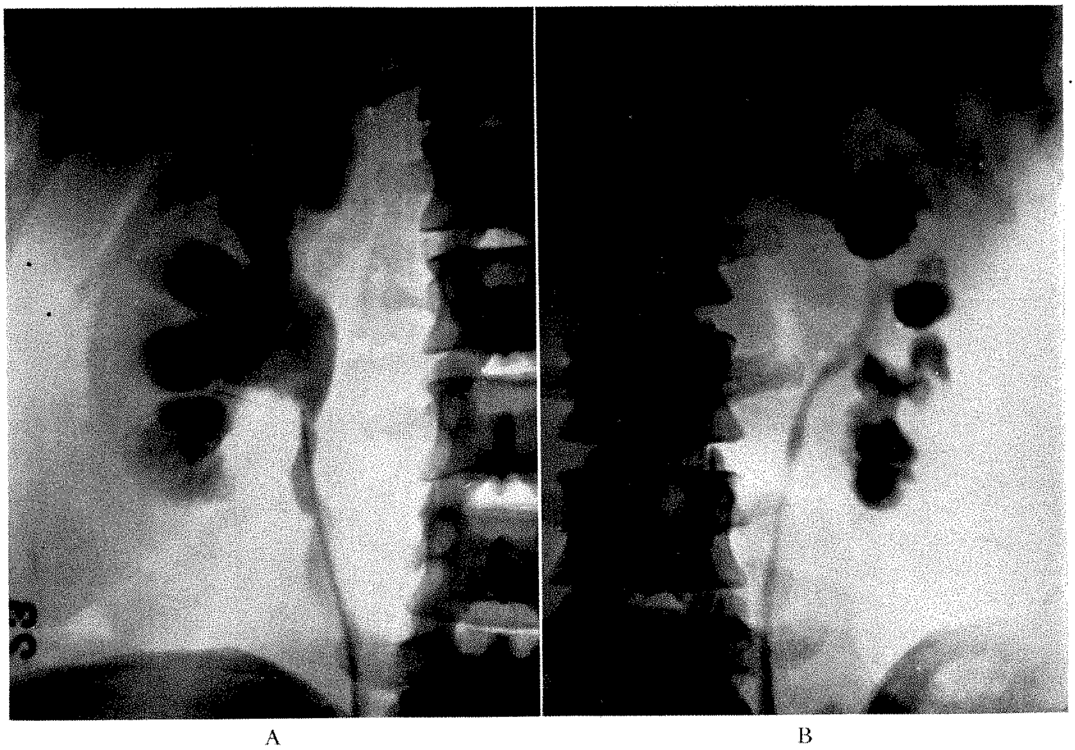


FIG. 3 A and B. Pyelograms of infected kidney.

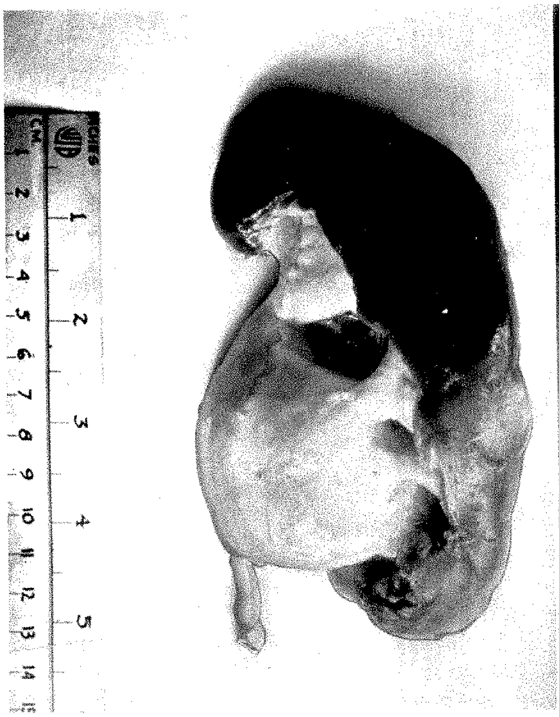


FIG. 3 C. Infected kidney with hydronephrosis after nephrectomy.

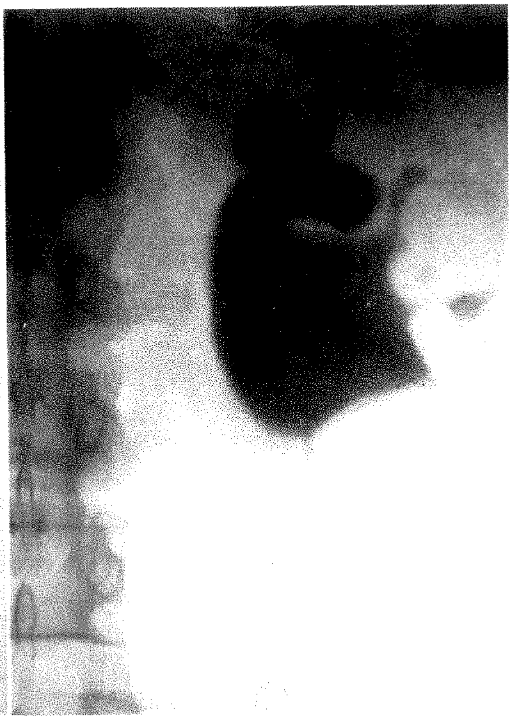


FIG. 3 D. Pyelogram of C showing dilated pelvis and obliteration of calyces in the lower pole due to infection and resecting scar-tissue contractions.

there is usually not a corresponding enlargement of the calyces. On the other hand, when the pelvis is small the calyces usually are correspondingly small.

Normally, in most individuals, the capacity of the pelvis is the same in both kidneys, although occasionally the capacity of one pelvis may be much larger than that of the other. Normally, the kidney pelvis extends somewhat downward and toward the spine; in a case of rotation of the kidney, however, its position may be reversed (Fig. 4 B C D and E).

The major calyces, extending from the pelvis toward the periphery, may assume a variety of shapes and sizes, and any one of them may be longer than its fellows. While they are usually three in number, in some individuals there may be only two and in others, there may be four. In some instances a calyx may be divided into two, or more subdivisions. The middle calyx may be small or rudimentary or may be absent. Roentgenograms will often show an apparent anastomosis of the major calyces but on examination of the kidney after its removal this is found to be due to a superimposing of the shadows of the injected calyces.

The minor calyces which also are somewhat pyramidal in appearance are formed by the projection of the minor papillae into the ends of the calyces, their bases thus acquiring a somewhat cup-shaped appearance with sharp clean-cut edges. In the roentgenogram, however, an end view of some of these is presented, so that they produce a rounded dense shadow not unlike a calculus in appearance.

The above descriptive notes give a general perspective of the great variety of appearances of normal kidney pelves with which the roentgenologist must be familiar before he can interpret pathological changes.

It is important also to understand the normal suspension and fixation of the kidney and ureter. The kidney is held in position by the adipose capsule, the renal fascia and the intra-abdominal pressure of the neighboring viscera. The ureter is supported independently of the kidney by its fixation anteriorly to the surface of the peritoneum. This is an important point to bear in mind in the consideration of kinks in the ureter as a causative factor of hydronephrosis.

An understanding of the possible etiological factors is essential to the correct interpretation of pyelograms made for the determination of a hydronephrosis.

1. *Abnormal Renal and Ureteral Development.* Only such abnormalities as are demonstrable by urography are pertinent to this study. These, which range from a slight deviation from the normal to a pronounced degree of abnormality include the following:

(*a*) Duplication of the renal pelvis.
(*b*) Dystopic or pelvic kidney.
(*c*) Double or bifurcated ureter.
(*d*) Fused or horseshoe kidney.
(*e*) Congenital increase or decrease in the size of the kidney pelvis.

2. *Acquired Abnormal Conditions.*
(*a*) Renal mobility, resulting in movable kidney.
(*b*) Renal torsion.
(*c*) Pelvic kidney.
(*d*) Aberrant vessel not demonstrable by roentgen examination (Fig. 6).

3. *Active Etiological Factors.*
(*a*) Infection—commonly colon bacillus infection, or tuberculosis (Fig. 3).
(*b*) Trauma.

Long-continued colon bacillus infection in many cases produces renal mobility or a sagging of the kidneys which is responsible for the obstruction of the urinary flow and the resultant dilatation of the kidney pelvis. Some cases show a developmental anomaly in conjunction with the infection, which was either the cause or at least a contributing factor in the process of development of the condition. Tuberculosis usually results in dilatation of the kidney pelvis, in areas of cortical necrosis, and in stricture of the ureter. However, if the infection is confined to the cortex the pelvis may become smaller, with a resultant contraction. If stricture of the ureter occurs, then obstruction with dilatation is the result. The irregular outline of the kidney pelvis which often results from tuberculosis has been described by Braasch as having a "moth-eaten appearance" (Fig. 3 B).

MEDICINE U. U.

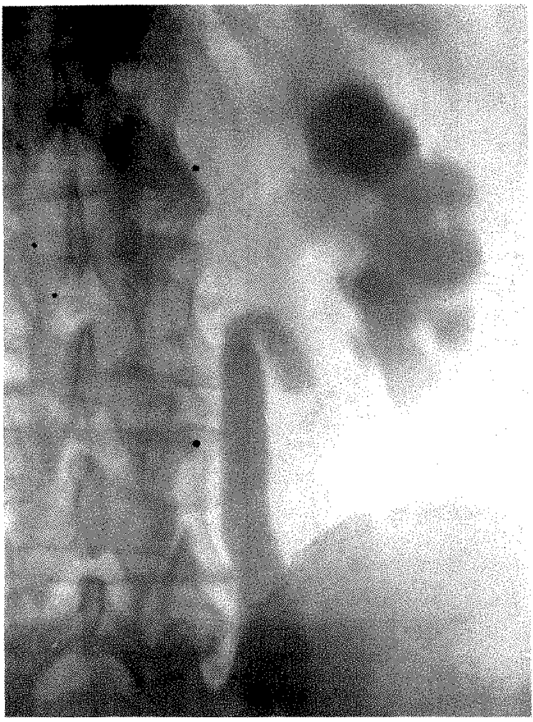


Fig. 4 A. Hydronephrosis and hydro-ureter due to old cystitis with patulous uretero-vesical orifice

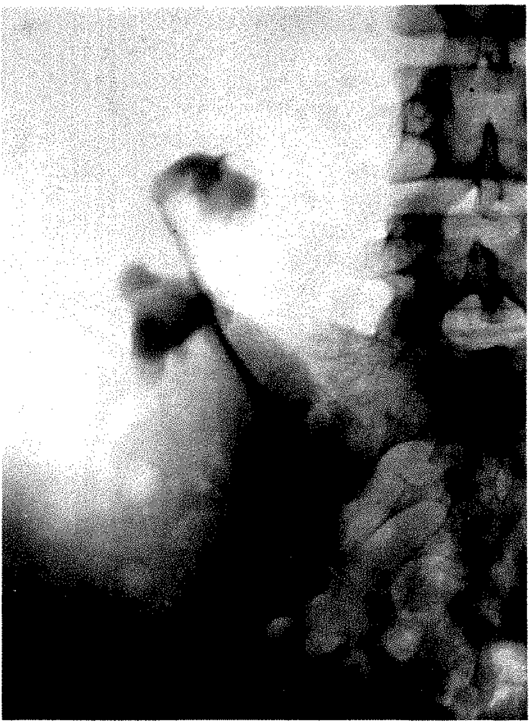


Fig. 4 B. Hydronephrosis in ectopic kidney.

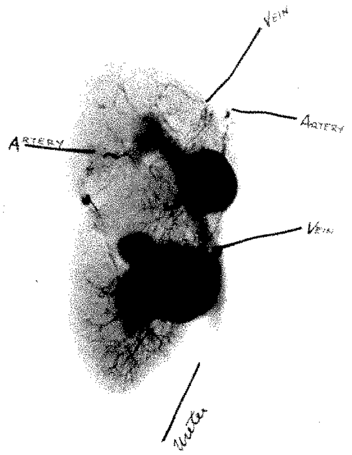


Fig. 4 C. Roentgenogram of kidney shown in B after removal.

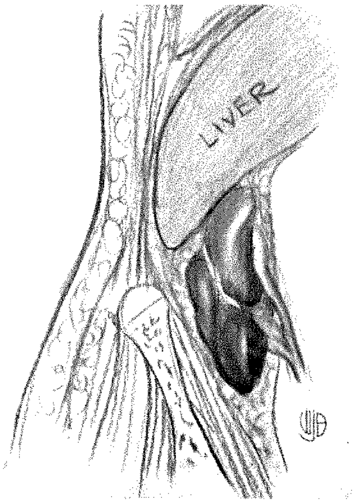


Fig. 4 D. Drawing of kidney shown in B as it appeared at operation.

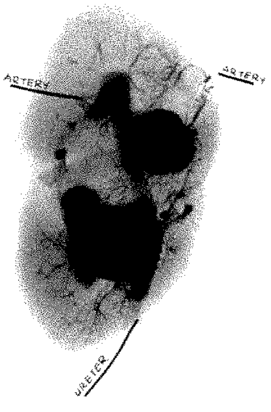
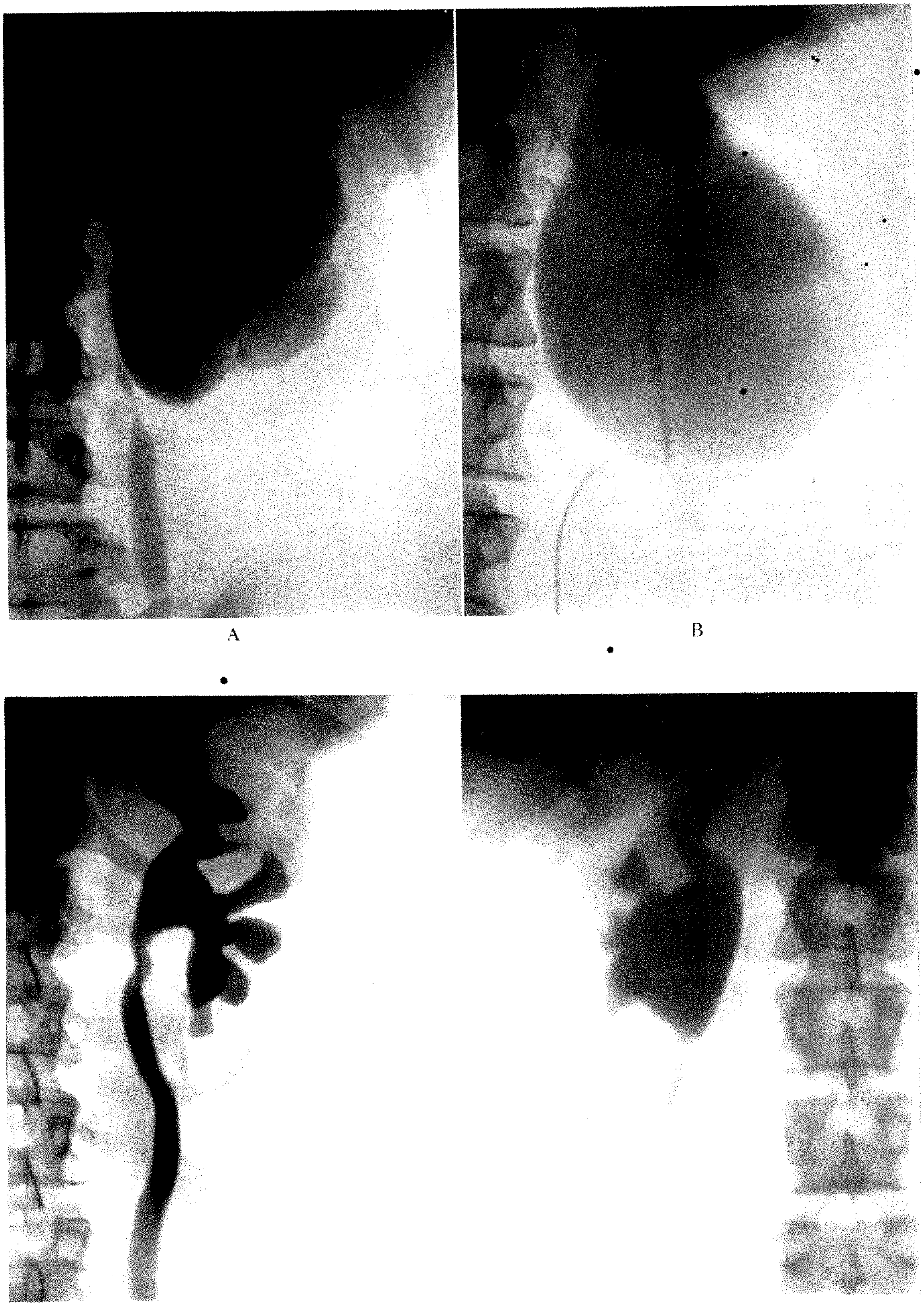


Fig. 4 E. Roentgenogram of kidney shown in B after removal.



A B

C D

Fig. 5. Pyelograms showing hydronephrosis of the obstructive type.

4. *Direct Etiological Factors.*

(*a*) Obstruction — Strictures, Stones, Tumors

(*b*) Motor insufficiency with a patent uretero-vesical orifice such as is seen in an old hydronephrosis following a chronic cystitis (Fig. 4 A).

(*c*) Central nerve crises.

These conditions include the more important etiological factors in the production of hydronephrosis.

The essential technique for the demonstration of a hydronephrosis must be properly carried out, particularly in early cases. If possible, all residual urine should first be drained from the pelvis of the kidney as it is necessary that the injection completely fill the pelvis and all of the calyces. During the exposure of the films there should be no motion on the part of the patient. The films should show the minor calyces distinctly. In many cases two or more films should be exposed with the patient in different positions in order to demonstrate the mobility of the kidney. Calculi in the ureter are usually easily demonstrated, the pyelogram showing the resulting dilatation of the ureter and hydronephrosis above the stone (Plate V C).

A dilatation of the ureter below the stone is sometimes seen. This is due either to infection or to a calculus which has been passed.

A dilatation of the ureter shown by the injected medium may be the result of an unusual elasticity of the ureteral wall in a perfectly normal ureter. The ureter frequently shows angulation and kinks, which are sometimes due to mobility of the kidney. On account of the independent fixation of the ureter it does not descend with the kidney. Such conditions as these, however, cannot be considered as pathological unless pathological changes resulting from the obstruction can be seen in the kidney pelvis.

The first indication of a beginning hydronephrosis is often difficult to determine. If the kidney pelvis has a capacity of 20–25 c.c. of solution there is usually a hydronephrosis; but some normal kidney pelves are capable of being dilated to this extent, so that the capacity of the pelvis of itself alone will not determine the disease. This alone, to my mind, answers the question as to whether or not the kidney pelvis should be filled under the fluoroscope. The fluoroscopic determination of a filled kidney pelvis is of no value because an injection, to be of diagnostic value, must be continued until the patient experiences a sense of pain—the incidence of pain indicating that a sufficient quantity of the solution has been injected.

If we are satisfied that the kidney pelvis has been completely filled and one or more pyelograms have been properly made; if the history has been taken carefully and all potential etiological factors have been considered, then in the presence of positive findings we may with reasonable assurance make a diagnosis of hydronephrosis.

The first evidence of hydronephrotic changes shown by a pyelogram is a dimness of outline and inflation of the minor calyces (Plate I D) which should appear in the terminal projections of more than one of the major calyces. These appearances are in contrast to the sharp clear-cut outline of a minor calyx in a normal kidney pelvis (Fig. 1 B) and is the first change to take place in the development of hydronephrosis. The next change which may be seen is a widening of the bases of the major calyces, giving the so-called plug-hat calyx described in 1919 by Keyes (Fig. 5 C). This is followed by an enlargement of the kidney pelvis. As the pressure in the kidney continues, the major calyces become widened, not only in their bases but throughout their whole extent; the minor calyces disappear; the angle formed by the ureter at its entrance into the kidney pelvis becomes more acute; and the pelvis becomes more dilated. These are the changes of prime importance in the early diagnosis and they must be definitely defined in order to establish the differentiation of a large normal kidney pelvis from an early hydronephrosis. In some cases the determination of an abnormality necessitates a comparison of the two kidneys, as usually the two pelves will be of equal size in a normal case, while in a case of hydronephrosis only the

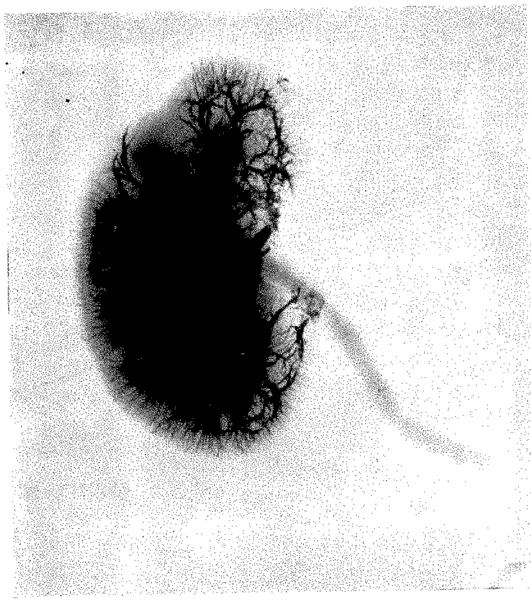


Fig. 6 A. Blood supply of kidney showing an extra blood supply to the lower pole.

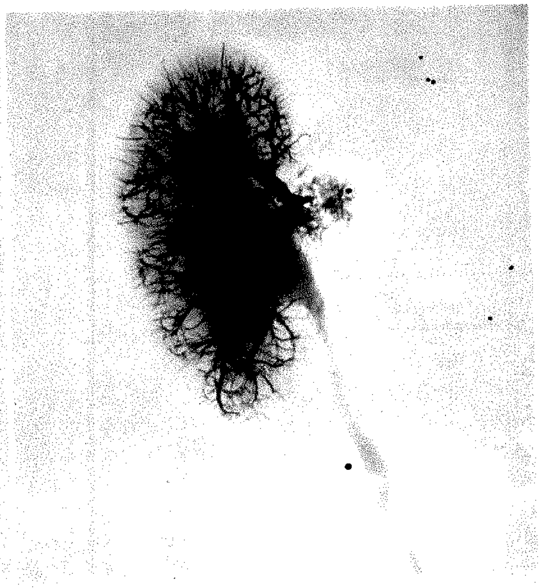


Fig. 6 B. Normal blood supply of the kidney.

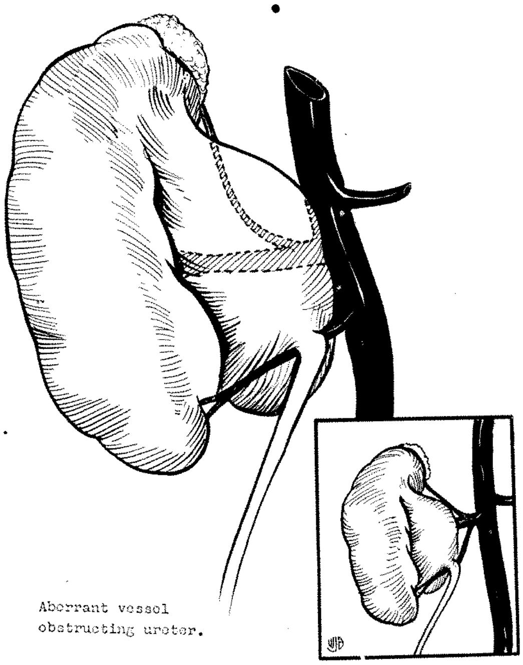


Fig. 6 C. Schematic drawing showing aberrant blood supply; in one instance the vessel is given off from the abdominal aorta and in the other from the renal artery.

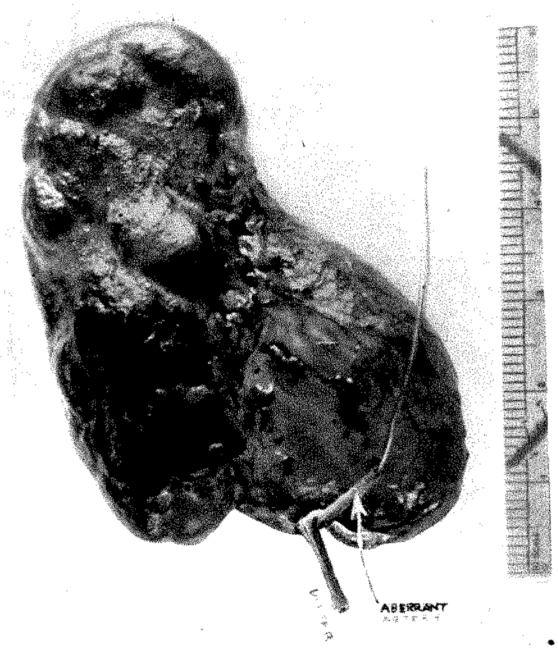


Fig. 6 D. Removed kidney, with hydronephrosis resulting from an aberrant vessel.

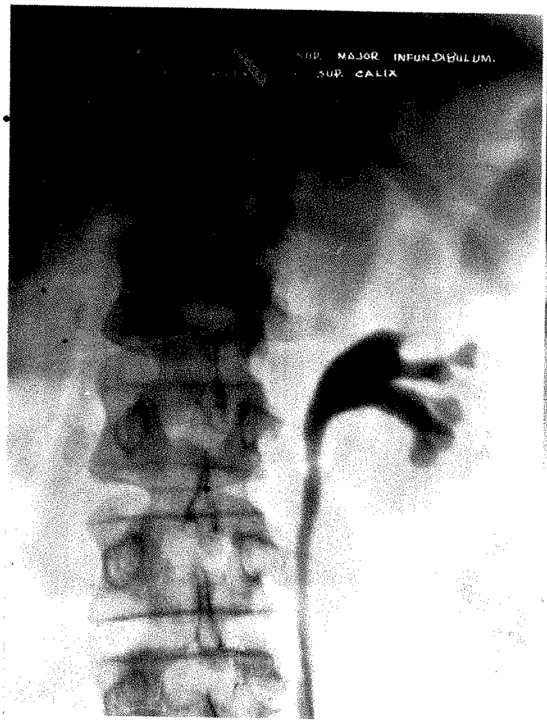


Fig. 7 A. Kidney pelvis with no solution in upper calyx because of stricture of infundibulum.

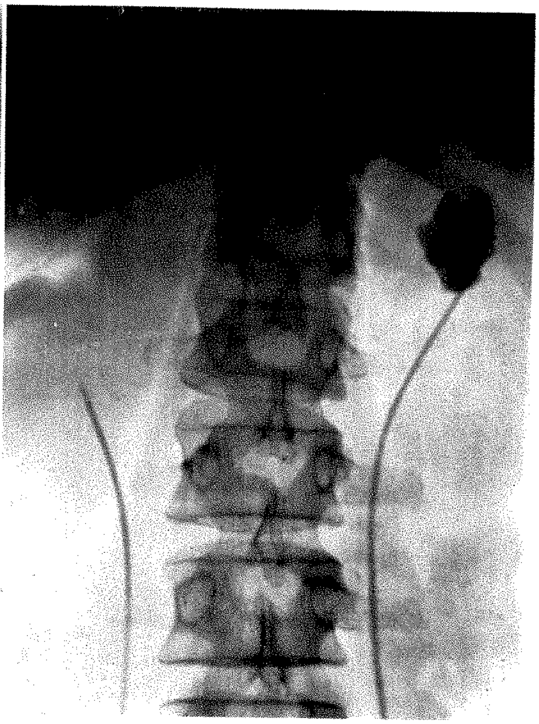


Fig. 7 B. Localized hydronephrosis of upper calyx showing calculus in stricture.

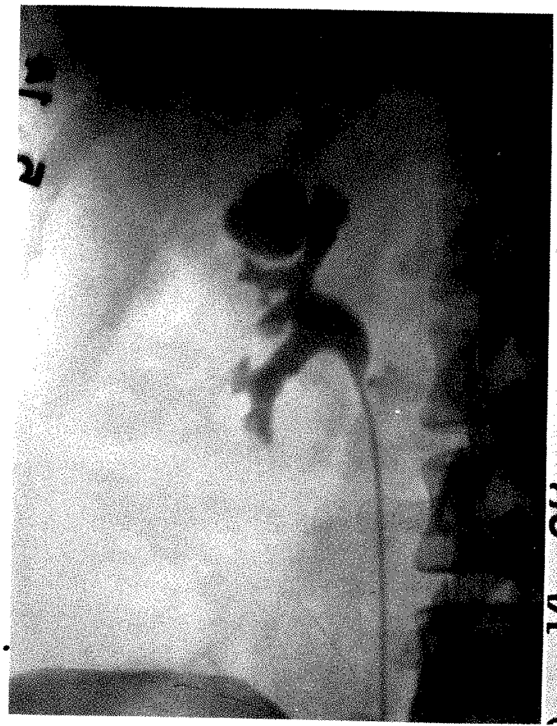


Fig. 7 C. Localized hydronephrosis of upper calyx of right side due to obstruction from small stones in the calyx.

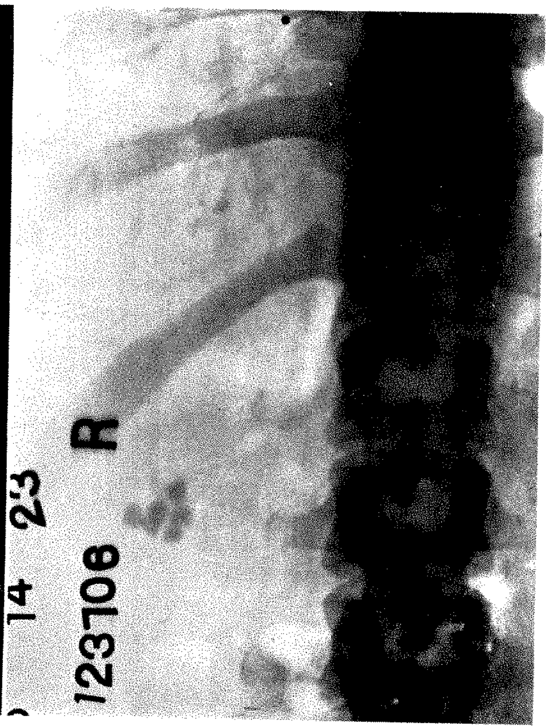


Fig. 7 D. Stones in C simulating gall-stones.

pelvis on the affected side will be enlarged. In an advanced case of hydronephrosis the diagnosis can usually be established by a cystoscopic examination with catheterization of the ureter, although often a pyelogram is necessary. In the advanced case the following changes will be noted: Extensive dilatation of the pelvis (Fig. 5 A and B); rounded individual areas and dim areas suggesting diluted fluid; the major calyces will not only have become broadened but they will be shortened until they may present only a shallow indenture into the smooth contour of the hydronephrotic sac.

SUMMARY

The important points in the establishment of the diagnosis of hydronephrosis may be briefly summarized as follows:

1. Familiarity with possible deviations in the normal kidney pelvis.
2. Determination of the probable etiology, if possible.
3. Employment of a technique which will produce films showing a sharp contrasting outline of the injected medium.
4. Assurance that the kidney pelvis is completely filled by continuing the injection until the patient experiences a sensation of pressure or pain in the region of the kidney.
5. Appearance in the pyelogram of the *definite* changes in the kidney pelvis and calyces which are characteristic of hydronephrosis.

DEEP ROENTGEN THERAPY OF NEOPLASTIC PULMONARY METASTASES*

BY

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THE early and frequent invasion of the lungs by metastases of malignant neoplasms has been long known. There are three reasons for this frequency of pulmonary involvement, these being concerned with the anatomy of the chest. First, the intrathoracic structures are extremely rich in blood vessels; second, there is an abundance of lymphatic vessels leading to and within the thorax; third, there is a proximity of the organs which are the most favorable places for the development of malignancies, such as the mammary glands, the stomach, the liver and the pancreas.

We can easily comprehend why the lung tissue is the most favorable place for all metastases, since, first, the dissemination of metastases of sarcomata and the mixed organoid tumors, such as teratoma, deciduoma, hypernephroma, etc., is by way of the blood system; second, the dissemination of carcinomata is generally by lymphatic permeation; and third, neoplasms often spread by direct extension through contiguity of tissue.

It is of additional importance that when such metastases have once invaded the lungs, death must follow, because of the vital importance of these organs, and the fact that until the advent of radium and roentgen therapy, no method of treatment could afford even partial relief. With this as a stimulus, and with the added incentive of being able to observe closely the changes brought about by intensive irradiation of chest tumors, we have for the past two years pressed our studies in this direction. In this communication, we wish to present the results of our observations.

We shall confine ourselves in this paper entirely to malignant blastomata, sarcomata, carcinomata and the mixed organoid tumors. We shall deal in another paper with malignant tumors which also invade the lungs, such as, for example, Hodgkins' disease, leucosarcoma, etc., because we believe that here the chest findings are merely local manifestations of a constitutional disease. For the same reason, lymphosarcomata will be considered in this latter group, for a lymphosarcoma is not a pure metastasizing malignant tumor, but a condition the progress of which merely simulates the course of an infectious disease.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

GENERAL PRINCIPLES OF TREATMENT

When treating malignancies of the lung, two very important principles have to be considered: First, it is essential that the necessary biological dosage of radiation should be administered to the tumor tissue itself; second, the normal lung tissue must be protected from all damaging changes as a result of the radiation. Unfortunately, the effects of the radiation on these two tissues are diametrically opposed. While the neoplastic tissues as a rule show a decreasing sensitiveness toward repeated radiation, the normal lung tissue itself shows increasing sensitiveness, especially after a certain limit of dosage has been exceeded. Thus we observe, when treating malignant growths of any part of the body, that following the first application, there is a very striking reduction in the size of the tumor, but when a recurrence appears or when it is necessary to give further treatments for the original mass, the reduction is less rapid and the recurrence is more refractory. On the other hand, when the normal lung tissue is repeatedly exposed to the action of deep roentgen rays, an increasing sensitiveness develops, causing changes which may result in permanent damage to the radiated lung. The complexity of our problem in bilateral pulmonary involvement is thus obvious.

Therefore, it becomes necessary to work out a technique which, while taking care entirely of the lesions themselves, will prevent the production of such secondary changes that are, as in their later stages, sufficient in themselves to cause death. This point will be taken up later in our paper.

1. *Treatment of Sarcomata.* We have no accurate figures, but various authors estimate the frequency of metastases of sarcomata as high as 85 per cent. The rich blood-vessel supply of these tumors, the repeated hemorrhages following necrosis within the tumor mass, and the tendency of sarcomatous cells to break through the walls of the veins of the adjacent tissues make the dissemination by blood vessels the most common route of extension. The embolic cells, once they have invaded the blood stream, are carried to the heart where they may be arrested, but more frequently are carried by the pulmonary circulation to the lungs where they regularly lodge in the parenchyma, thus producing the well-known picture of diffuse metastatic pulmonary sarcoma. The lungs have a filtrating effect on the blood stream, retaining, or at least endeavoring to retain, all of the emboli circulating in the blood. On the other hand, the tendency of the majority of sarcomata to grow upon the vascular framework explains why metastases are formed in the earlier stages of the disease and why the radical removal of the primary lesion is in most cases of only palliative value.

Among our treated cases of sarcomatous metastases to the lungs, were those which had had previous surgical treatment for the primary lesion, and also those which, on account of the advanced stage of the disease, had had irradiation only, both to the primary and secondary lesions. The variation in the results obtained would lead to the conclusion that there is a definite selective reaction of the different sarcomatous groups toward irradiation. For instance, while a metastatic angiosarcoma of the lungs may quite disappear in from three to six weeks following the treatment, metastases of periosteal sarcomata are apparently entirely refractory to irradiation, even in the earliest stages, at least to the dosage which we have used.

The other sarcomatous groups occupy an intermediate position, some of them clearing up following the first series and others apparently needing repetition of the treatment, which, as we shall see, is often impossible because of the marked lung changes incident to the heavy radiation.

These variations in the response of the different sarcomatous groups to radiation show plainly that the structure of these tumors is of extreme importance. However, the morphological structure of sarcomata,—the spindle-celled, round-celled and giant-celled groups—is not the only determining factor in their susceptibility to irradiation.

We have seen, for example, a spindle-celled sarcoma originating from the broad ligament, with wide-spread metastases, clear up entirely under roentgen treatment, and this patient is now, almost one year after the treatment, in good health; while a spindle-celled sarcoma, originating from the periosteum of the lower end of the femur and which had produced lung metastases (Figs. 10 and 12) showed not the least response to irradiation. Indeed, it seems that the histogenetic structure plays a still more important part in the radiosensibility of sarcomata than the morphological structure.

Angiosarcomata are tumors of the extreme embryonal type, being rich in vascular tissue and apparently free of paraplastic structures, with the cells highly undifferentiated. They are rich in chromatic nuclear substances and show abnormal morphology. This type of cell is especially susceptible to irradiation. Figures 1 to 6 and Figures 7–9 show the good results obtained in two such cases of metastatic angiosarcoma of the lungs. In the first case, the primary lesion was in the iliac bone (Fig. 1). This was successfully treated by deep roentgen therapy eighteen months ago (Fig. 2), but six months later metastases developed in the lungs (Fig. 3) although there was no evidence of a local recurrence. Appropriate treatment was given for the pulmonary involvement and three weeks after the treatment the lungs had become entirely clear (Fig. 4). Immediately following the treatment there was an improvement in the patient's general condition, and she early returned to normal, in which condition she has remained (Figs. 5 and 6). In the second case, the primary lesion was on the thigh, and when deep roentgenotherapy was instituted, the patient already had advanced metastases in the lungs (Fig. 7) and his condition was rapidly deteriorating. Three weeks following the treatment, there was a marked improvement in his condition, but the metastases had not entirely disappeared (Fig. 8). Six weeks following the first application of deep roentgen ray a second series was given, limited to the roots of the lungs. Following this treatment, all metastases

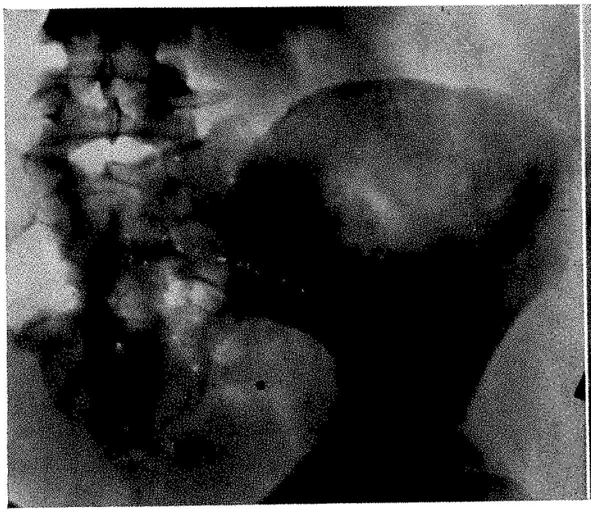

Fig. 1. Primary angiosarcoma of the iliac bone, with considerable destruction of the bony structures.

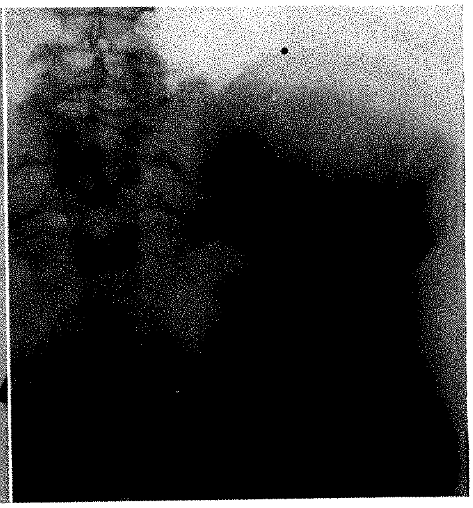

Fig. 2. Same case as in Figure 1, one and a half years after deep roentgen treatment. There is a complete reorganization of the bony structure. No local recurrence for one and a half years.

disappeared (Fig. 9) and the primary lesion also is almost healed, with the patient's general condition good.

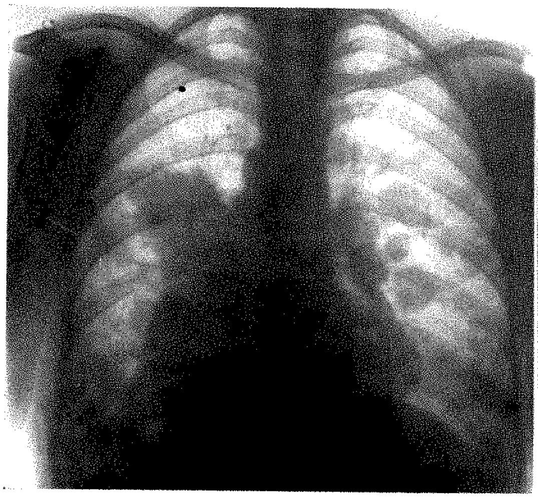

FIG. 3. Same case as in Figure 1, six months after the treatment of the primary lesion. Extensive metastases developed in the lungs.

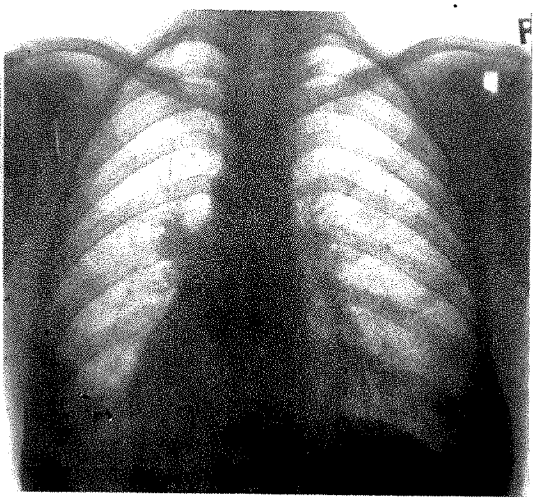

FIG. 4. Same case as in Figure 3. Three weeks after the treatment of the secondaries, the lung fields have entirely cleared up. No evidence as yet of infiltration of the normal lung tissue due to the effect of radiation.

Periosteal sarcomata metastasizing to the lungs are usually of the spindle-celled type. These tumors, in contrast to the angiosarcomata, are tumors of adult fibroblastic nature. The cells are spindle-shaped, small and highly differentiated, and there may be a rich intercellular substance (for instance, fibrous or osteoid). These tumors show a low susceptibility toward irradiation, and the results, even in the early stages, using the present technique are unsatisfactory. Figure 10 shows beginning lung metastases of a spindle-celled periosteal sarcoma of the lower end of the femur. The primary lesion had been treated

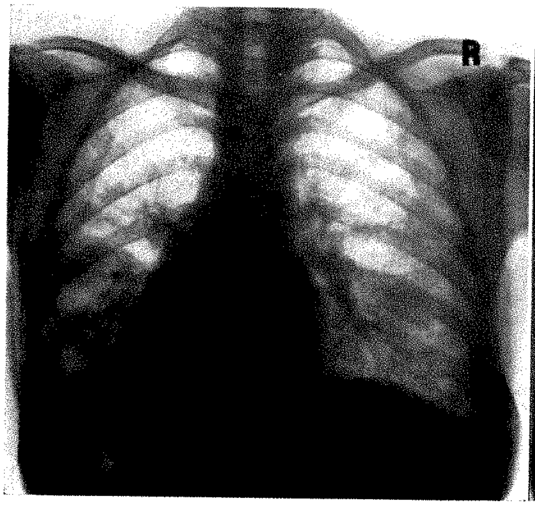

FIG. 5. Same case as in Figure 3, six months later. No recurrence of the secondaries in the lungs. However, at this time there is an infiltration around the roots of the lungs, typical of central pneumonia, which is due to the effect of the radiation on the normal lung tissue.

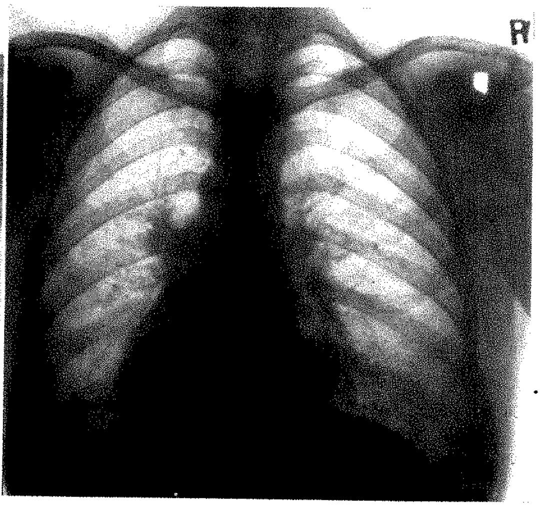

FIG. 6. Same case as in Figure 3, one year later. The infiltration of the lungs has disappeared. At this time the lung fields show practically normal appearance. There is only slight accentuation of the hilus shadow.

by irradiation, which was followed by amputation of the leg, but shortly after the operation lung metastases had appeared. Deep roentgen treatments were given for these lesions, using the same technique as in the above-mentioned angiosarcomata, but in spite of the treatment the metastases continued to spread (Figs. 11 and 12) and the patient died three months later.

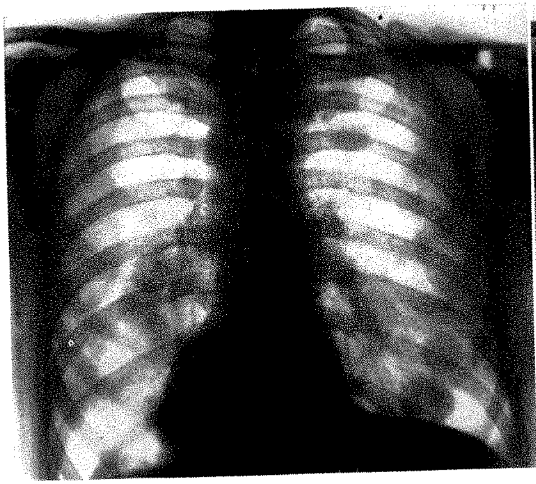

FIG. 7. Metastatic angiosarcoma of the lungs. Primary lesion in the thigh.

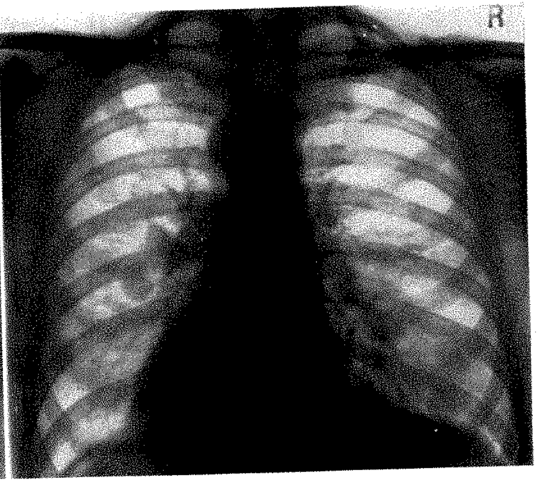

FIG. 8. Same case as in Figure 7. Six weeks after deep roentgen-ray treatment was applied to the secondaries as well as to the primary lesion. Most of the nodules have disappeared. Only a few nodules left around the hilus. The primary lesion is reduced to half its original size. At this time treatment was repeated for both the primary and the secondaries. The treatment of the lungs included only the parts around the hilus.

The other sarcomatous types metastasizing to the lungs occupy an intermediate position between the two types described. The nearer they come to the undifferentiated embryonal type, the better the results from the treatment, and the nearer they are to the adult tumors, rich in parablastic structures, the less the chance for successful treatment.

2. *Treatment of Carcinomata.* Since the usual method of extension of carcinomata is dissemination by way of the lymph vessels or extension by direct contiguity, it is evident that metastatic carcinomata of the lungs are secondary to neoplasms originating in the organs in proximity to the chest, most frequently the mammary glands, and less frequently the stomach, pancreas, liver and thyroid.

Usually three types of metastases are described:

(*a*) Circumscribed mediastinal metastasis. This usually appears in the posterior mediastinum in the form of nodules of different sizes, similar to the nodules in the axillary glands. Nodular metastases involving the anterior mediastinum are less frequent, occurring usually secondarily to malignancy of the thyroid gland or the breast, when the dissemination occurs by way of the pectoral lymphatic plexus

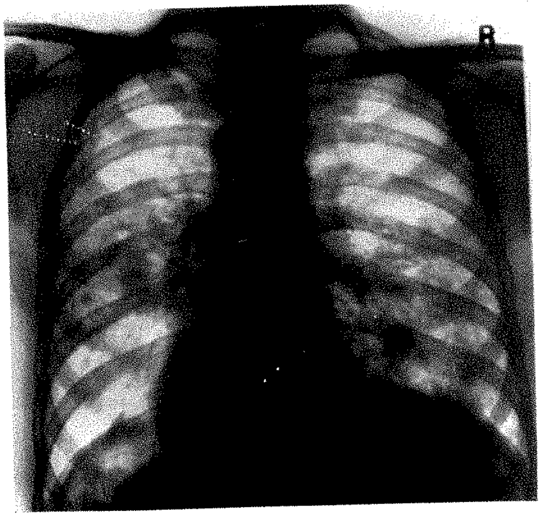

FIG. 9. Same case as in Figure 7, six weeks after the second application of radiation. All the nodules have disappeared, but at this time there is infiltration of the lungs, similar to that described in Figure 5, no doubt due to the effect of the radiation on the normal lung tissue. Primary lesion almost healed.

and the perforating branches running to the mediastinum. In our case (Fig. 13) the primary lesion was a carcinoma simplex of the breast, successfully removed by a radical operation. Eight years later the patient developed metastases in the anterior mediastinum. This was treated by deep roentgen rays and in six weeks the mass had entirely disappeared (Fig. 14). The patient is now symptom-free.

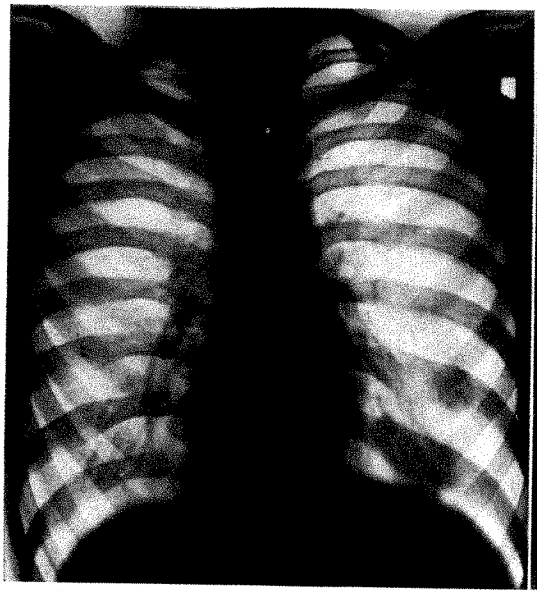

Fig. 10. Beginning metastasis of the lung (right lower lobe) after primary spindle-celled, periosteal sarcoma of the lower end of the femur. Preoperative radiation of the primary lesion and later amputation of the leg were performed.

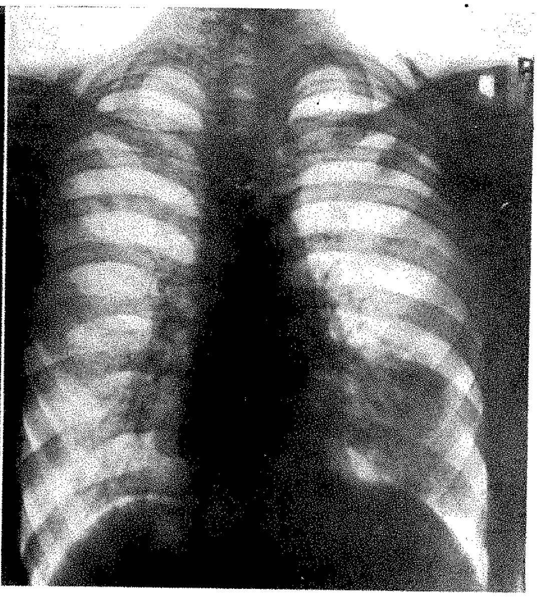

Fig. 11. Same case as in Figure 10, six weeks later. In spite of the treatment, lesion is continuing to spread.

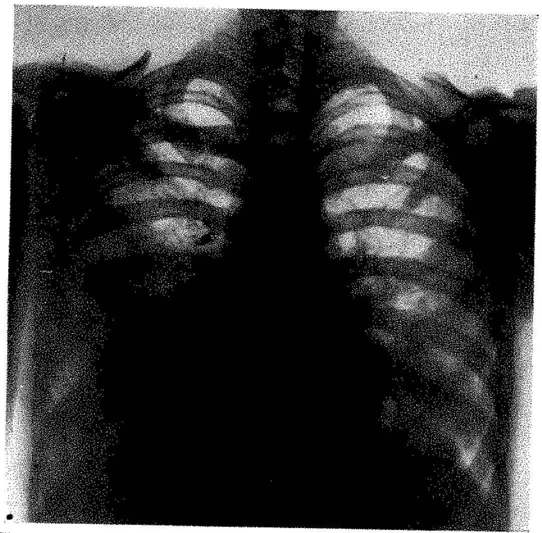

Fig. 12. Same case as in Figure 10, ten weeks after the treatment. The lesion is rapidly spreading. Patient died three months after treatment.

(*b*) Infiltrating lymphangetic metastasis. This form of metastasis usually produces a broadened mediastinal shadow, from which the carcinoma spreads in the form of thick-walled, shadowy structures outward and upward, with a shading off of the process in the normal lung tissue. At the periphery there is a radiating appearance of the process, because the carcinoma infiltrates the lung tissue, especially along the bronchial tree. A typical picture of such an infiltrating lymphangetic metastasis is shown in Figure 15. The primary lesion in this case was a carcinoma simplex of the breast. About three months after the treatment, one single dose having been applied, the lesion had entirely disappeared (Fig. 16) and the plate taken almost one year later (Fig. 17) still shows, except for slight fibrotic changes, the lung fields to be entirely clear. The patient is now free of untoward symptoms.

(*c*) Miliary metastasis. This form of metastasis is not so rare as was thought a few years ago. Systematic roentgenographic examinations of the chest in all cases of carcinoma result frequently in the demonstration of discrete areas of involvement of the lung parenchyma. Apparently these lesions are not productive of symptoms, but they are of extreme importance from the standpoint of treatment of the patient. At times the differential diagnosis between this type of lung malignancy and chronic submiliary tuberculosis is extremely difficult. We have treated several cases showing this type of lesion and the response to the treatment was satisfactory. We held that the prompt disappearance of the nodules after treatment verified the diagnosis of carcinomatosis and ruled against tuberculosis. In spite of the local improvement, these cases have a grave prognosis on account of the generalization of the lesion in the remainder of the body. At best, the improvement is only temporary, and probably life is prolonged but a few months. Figure 18 illustrates such a case. Six months following the roentgen treatment the lesions had practically disappeared (Fig. 19), but in the meantime the patient developed metastases to the liver, omentum and brain, and died eight months following the treatment. In these cases the metastases no doubt occur by way of the blood stream to every part of the body.

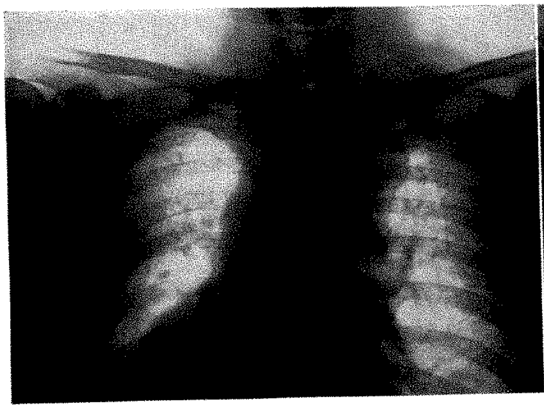

Fig. 13. Circumscribed metastatic tumor in the anterior mediastinum after primary carcinoma simplex of the breast, radically removed eight years ago. No evidence of local recurrence.

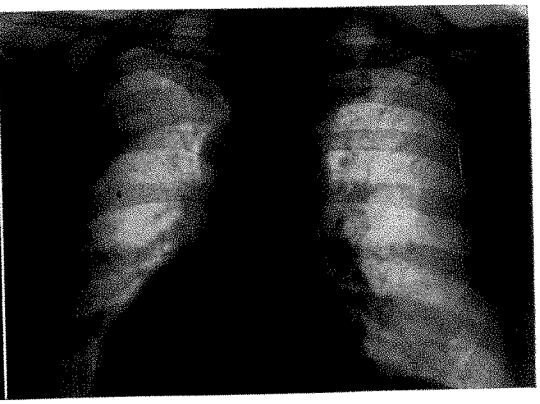

Fig. 14. Same case as in Figure 13, six weeks later. The tumor mass has entirely disappeared.

A fourth form of metastasis of carcinoma of the chest may be mentioned, that of localized involvement of the pleura by direct extension. Figure 20 illustrates such a case. The primary mass in the breast was removed by a radical operation. About two years later the patient developed metastases to the liver and omentum, accompanied by ascites. At this time, two metastatic nodules could be detected in the posterior pleural wall. The patient received a course of irradiation and there was a striking improvement in her condition (Fig. 21). The ascites disappeared, the liver went down to almost normal size, and the metastatic nodules in the pleura disappeared.

3. *Treatment of Mixed Organoid Tumors.* Our work in this connection is incomplete, but, judging from the good results obtained in treating these lesions in other parts of the body and the close relationship of these tumors to sarcomata, there is sufficient justification for treatment of this tumor group by irradiation.

COMPLICATIONS DUE TO THE EFFECT OF RADIATION ON THE PATHOLOGICAL AND NORMAL TISSUE OF THE LUNGS

There is voluminous literature by distinguished authors dealing with the effect of radiation on pathological tissues. It is, therefore, not our intention to discuss this subject here, for the effect of radiation on the pathological tissues of the lung is the same as anywhere else in the body; but we should like to consider the complications which may arise from such action on the tumor masses located in such a delicate and specialized structure as that of the lung.

1. *Hemorrhage of the Lung.* When deep, bulky tumors of the lung are subjected to intensive irradiation, extensive necrosis may be produced within the tumor mass, and in vascular growths such a necrosis may lead to a profuse hemorrhage, which is often fatal. One of our patients treated for a bulky carcinoma of the upper lobe of the left lung died three weeks following the treatment as the result of such a hemorrhage. The autopsy showed that practically all the tumor tissue was transformed into a necrotic mass; but few tumor cells remained, and these showed signs of hydropic degeneration (Fig. 22). Fortunately, this accident does not occur very often, because the defense system of the body has another way of fighting such radical changes. As a reaction to the degeneration which begins within the tumor mass, the organism develops an inflammatory process with fibroblastic proliferation around the tumor. A fibrotic capsule is developed which has a tendency to cut off entirely the tumor mass from its blood supply (Fig. 23). Later fibrotic bands penetrate within the tumor substance and simply strangulate the cells (Fig. 24) until the whole tumor is replaced by connective tissue. We made microscopic sections of a healed sarcomatous nodule of the lung of a patient who later died as a result of generalized metastases, and found that the entire nodule was transformed into dense, fibrotic tissue (Fig. 25); a few cells were left encapsulated within it.

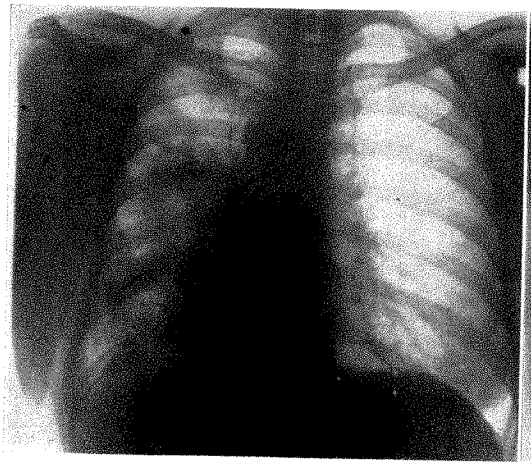

Fig. 15. Infiltrating, lymphangetic metastasis from carcinoma simplex of the breast.

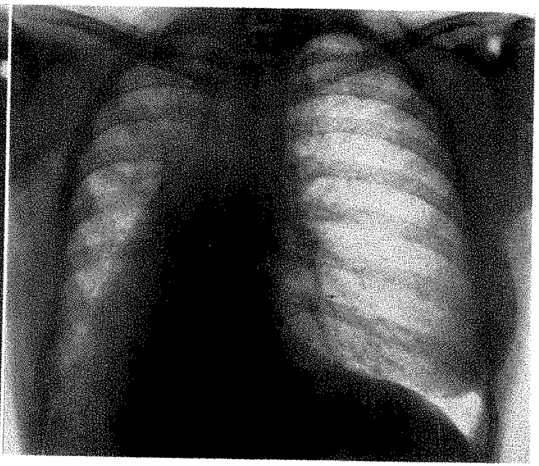

Fig. 16. Same case as in Figure 15, three months later. Lesion has practically disappeared.

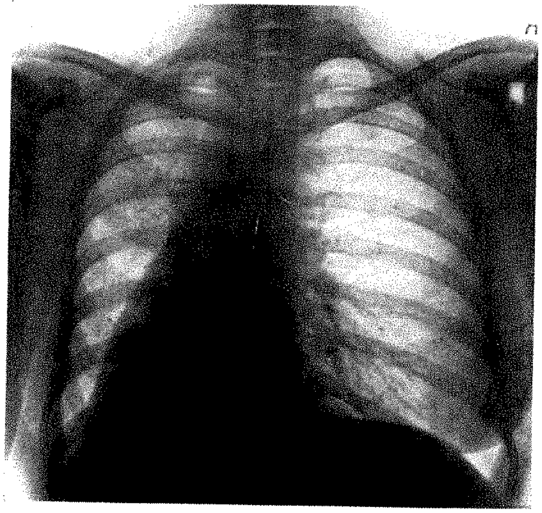

Fig. 17. Same case as in Figure 15, one year later. The lung fields, except for slight fibrotic changes, are clear.

2. *Rupture of the Lung.* This has the same origin as hemorrhage. The necrosis of a tumor nodule may lead to an open communication between the air cells, or bronchi, and the pleural cavity, and pneumothorax may develop (Fig. 26). Previous to the treatment there was a spontaneous pneumothorax on the right side which was probably caused by rupture of the lung due to the rapidly growing metastatic nodules; following the treatment, however, the pneumothorax on this side had cleared up and a pneumothorax

had developed on the opposite side (Figs. 27 and 28). The patient died later as a consequence of generalized metastases and the autopsy showed that the lung which was collapsed previous to the treatment was adherent to the chest wall, while the opposite lung was entirely atelectatic.

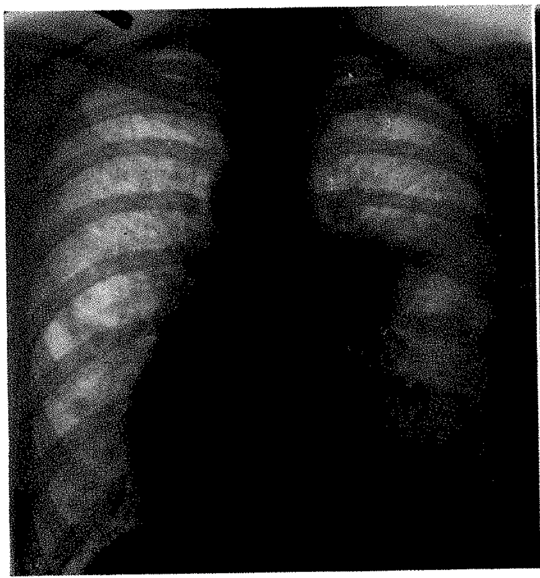

Fig. 18. Generalized miliary metastases to the lungs after primary carcinoma of the breast, radically removed two years ago.

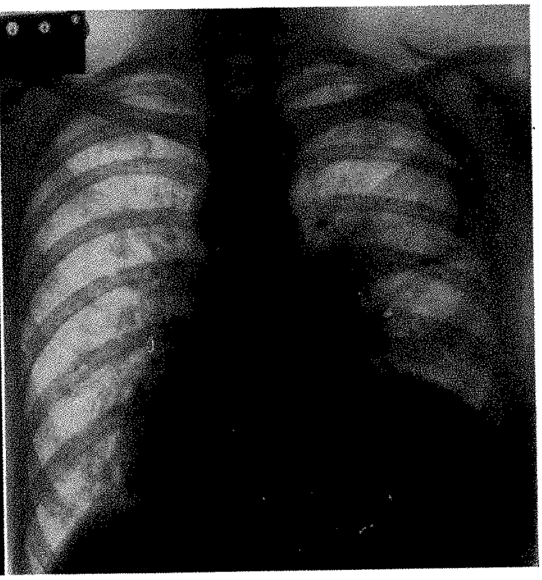

Fig. 19. Same case as in Figure 18, six months after radiation. The lung fields have practically cleared up. There is only fibrosis at the roots of the lungs; but owing to the considerable enlargement of the liver, followed by generalization of the metastases, the right leaf of the diaphragm is pushed up. Patient died two months later.

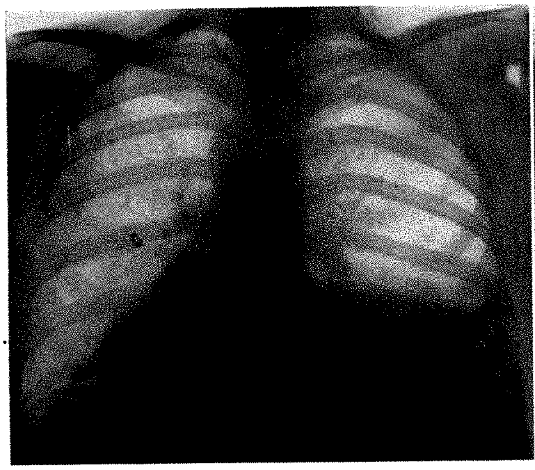

Fig. 20. Pleural metastases after primary carcinoma of the breast, radically removed about two years ago. Enormous enlargement of the liver with pushing up of the right leaf of the diaphragm; omental involvement with accompanying ascites, and two noduli in the posterior pleural wall.

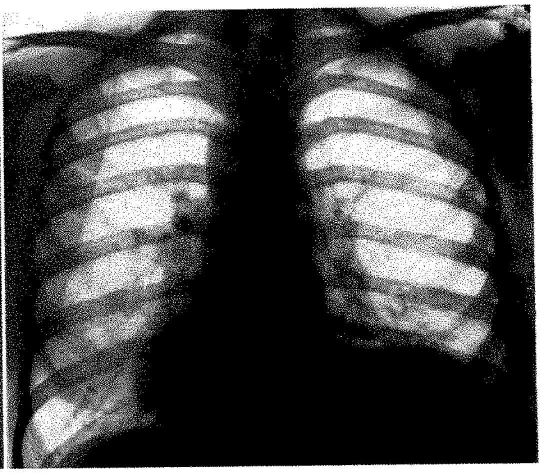

Fig. 21. Same as in Figure 20, about six months later. Liver has diminished in size; the ascites has been absorbed; and the metastatic noduli on the pleura have disappeared.

3. *Changes in the Normal Lung Tissue.* Far more important is the question as to whether or not heavy radiation of the lungs, such as is necessary for the treatment of sarcoma or carcinoma, will produce changes in the normal lung tissue which may lead to an impaired function of this vital organ. We subjected this question

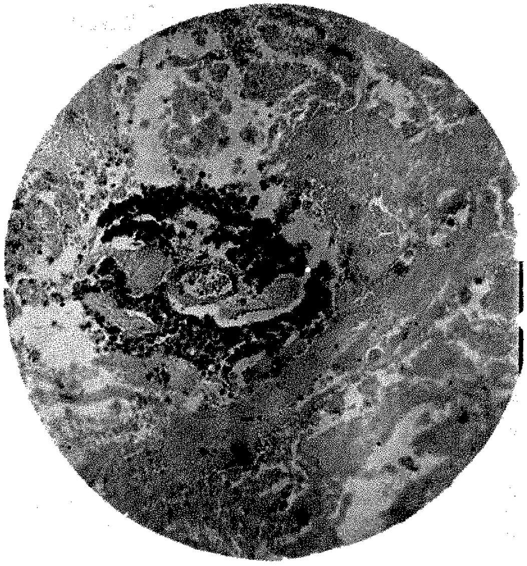

Fig. 22. Bulky carcinoma of the upper lobe of the left lung, destroyed by radiation. Practically all the tumor tissue is transformed into a necrotic mass. There are only a few cells left as an isolated island. There is hydropic degeneration of the remaining cells.

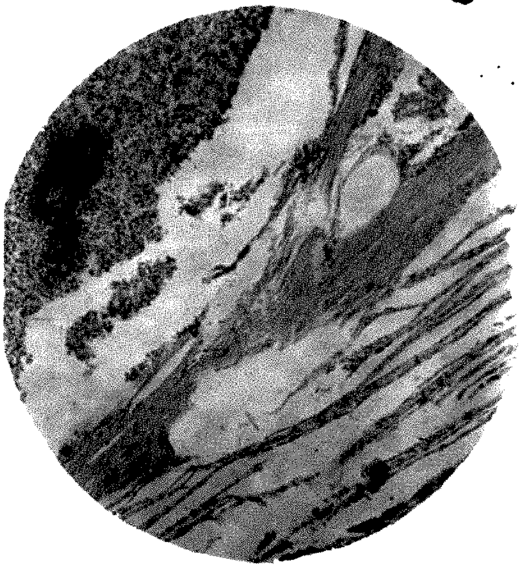

Fig. 23. Fibroblastic proliferation and formation of a fibrotic capsule around a tumor nodule treated by radiation. The tumor cells themselves are undergoing degeneration and in places there is marked, small, round-cell infiltration. The surrounding fibrotic tissue tries to encapsulate entirely the tumor nodule.

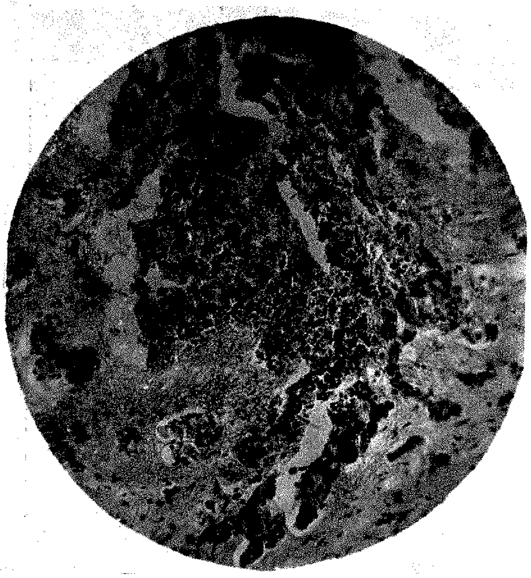

Fig. 24. Advanced fibrotic changes around an encapsulated, and in its greater part already destroyed, tumor nodule. Thick, fibrotic bands penetrate within the tumor mass and simply strangulate the cells.

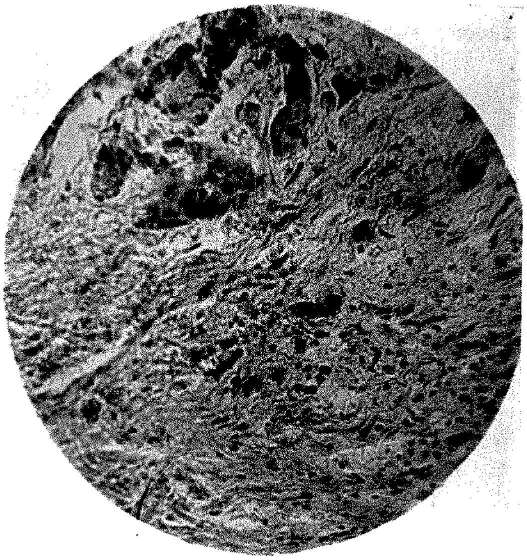

Fig. 25. The whole tumor mass is replaced by dense connective tissue. This is the end-result of a practically healed nodule. However, in many cases, as shown in this figure, cell islands are left within the scar tissue which maintain their vitality for long periods.

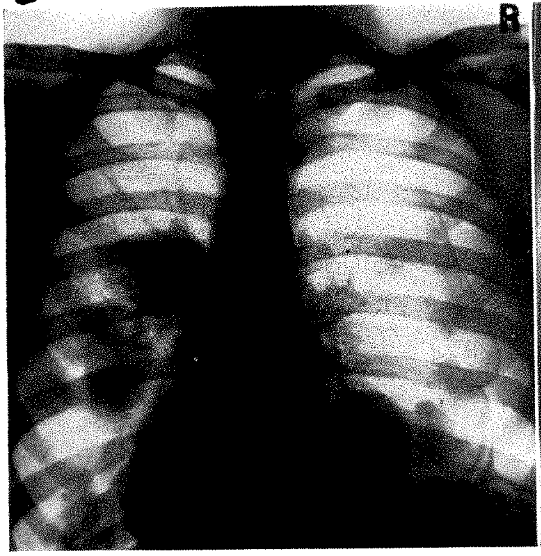

Fig. 26. Advanced sarcomatous metastases to the lungs after primary angiosarcoma of the pelvic bone. Rupture of the right lung with following pneumothorax: partial collapse of all three lobes of the right lung.

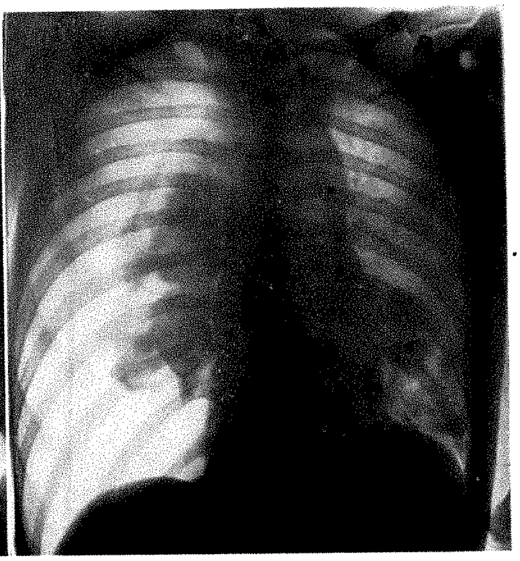

Fig. 27. Same as in Figure 26, six weeks after deep roentgen-ray treatment of the lungs. Most of the noduli have disappeared. The pneumothorax on the right side has cleared up but there is now a total collapse of the left lung.

to a thorough study and found that certain practical conclusions could be drawn. In another paper we shall expound in detail the results of this study. Here we should like to mention only the conclusions at which we arrived.

If a dose less than 60 to 70 per cent S. E. D. is administered over the entire lung fields, no changes whatever will occur in the lungs, but as soon as this dose is exceeded a *locus minoris resistentiae* is created, this not differing from that created in the lungs by other pathological conditions, as, for example, resolved lobar pneumonia. But, if an overdose or repeated high biologic doses are administered over the lungs, then certain changes occur. These are of two different types: (*a*) Early changes manifesting themselves as an *infiltration of the lungs* and (*b*) late changes appearing as *fibrosis of the lungs.*

(*a*) *Infiltration of the Lungs.* If a dose of 100 per cent S. E. D. is exceeded or if a dose less than 100 per cent S. E. D. is given over a *locus minoris resistentiae* of the lungs (this having been produced

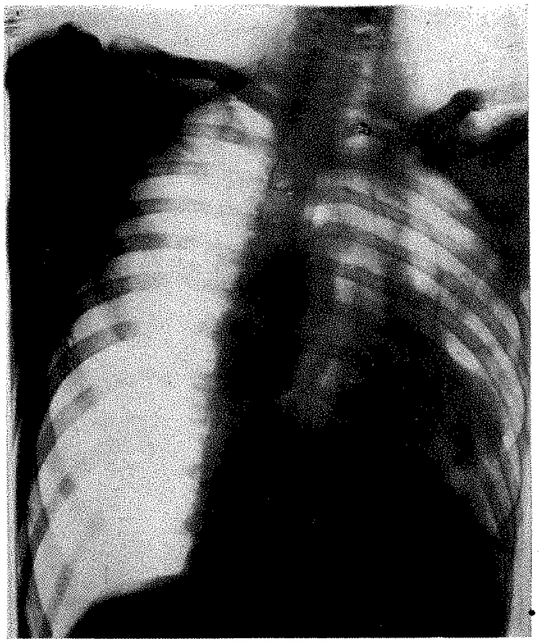

Fig. 28. Same as in Figure 26, ten weeks after treatment. The left lung is pushed almost entirely over to the right side as a result of the very extensive pneumothorax. Two weeks later, patient expired as a result of general metastases.

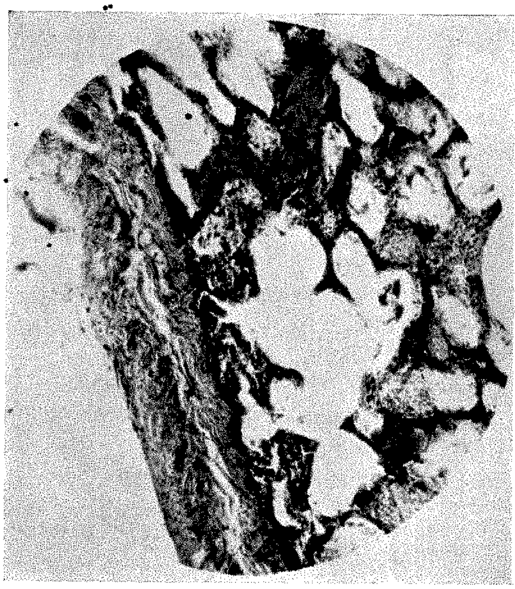

Fig. 29. Histological section of an area of the lung and pleura, showing infiltration due to the effect of the radiation. Most of the air spaces are filled with coagulum (edema) and desquamated epithelial cells. There is a small round-cell infiltration of the pleura.

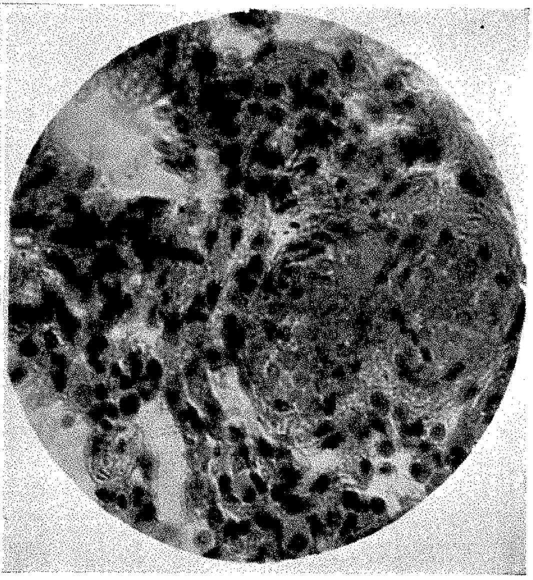

Fig. 30. Same as in Figure 29. High power. There is marked thickening of the alveolar walls. The air cells themselves are filled with desquamated epithelial cells and coagulum granuli. There is a leucocytic infiltration of the septa.

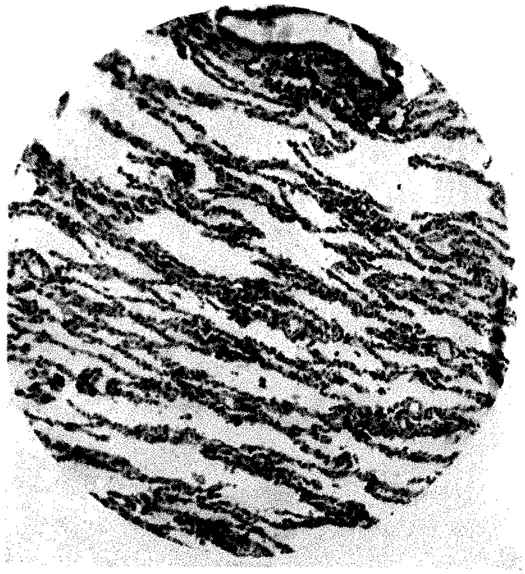

Fig. 31. Beginning fibrosis of the lung parenchyma, due to the effect of radiation. The leucocytic infiltration is replaced by fibroblastic proliferation. There is a diminution in the lumen of the air spaces, as a result of the compression by the proliferation.

by either previous roentgen-ray exposures not exceeding 100 per cent S. E. D. or by previous pathological conditions, such as lobar pneumonia, etc.), then characteristic changes develop. Figures 5 and 9 show the roentgenographic appearance of such changes. These changes usually start at the hilus like a central pneumonia, producing irregular, hazy, washed-out shadows around the roots of the lungs, which sometimes progress toward the lung parenchyma, but in the majority of cases remain localized to the hilus. Accompanying these changes, there is often a thickening of the pleura and the interlobar septa. The histological appearance of such a condition is shown in Figures 29 and 30; that is, marked thickening of the alveolar walls, and, secondary to this, compression with resulting diminution of the air spaces; desquamation of the epithelial cells; coagulum formation filling out the lumen of the air spaces (edema); and leucocytic infiltration of the septa. These are the most important features of such an infiltrative condition. At the same time there is marked reaction on the part of the pleura (Fig. 29). In the majority of cases this condition is absolutely harmless, and during the following two to six months a total resorption may follow and the lungs regain their normal appearance (Fig. 6).

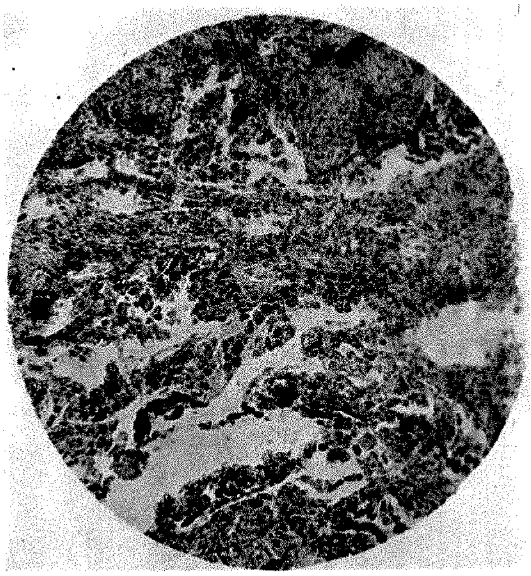

FIG. 32. A more advanced stage of fibrosis of the lung parenchyma, due to the effect of radiation. Most of the air spaces are entirely obliterated. The rest of them are compressed by the rapidly proliferating, connective tissue. There is marked hyperplasia of the perivascular connective tissue.

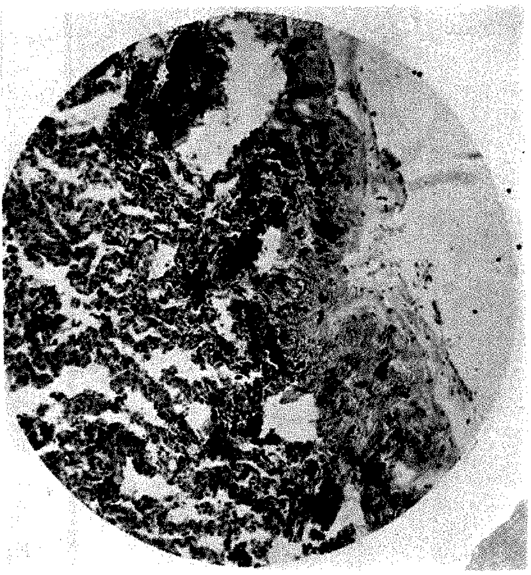

FIG. 33. Same as in Figure 32, but showing fibrotic changes at the periphery of the lung. There is formation of extensive fibrotic layers in the pleura. These layers grow toward the lung tissue, penetrating along the septa.

(*b*) *Fibrosis of the Lungs.* When a 130 per cent S. E. D. is exceeded or repeated (three or four heavy radiations given over the same area) entirely different conditions arise. In the majority of cases severe changes occur, similar to the induration of the skin after repeated deep roentgen-ray exposures (leather skin), due to vascular injury and fibrotic changes. The leucocytic infiltration is replaced by fibroblastic proliferation; this in turn leads to compression (Fig. 31), and later to total obliteration of the air cells (Fig. 32). In addition to this, there is marked hyperplasia of the perivascular connective tissue, and the pleura shows extensive formation of new fibrotic layers (Fig. 33) which grow toward the lung tissue, penetrating along the septa and separating the secondary lobules. Still later, the whole lung tissue may be transformed into a dense, connective tissue with complete destruction of the alveoli (Fig. 34). In such a histological section, only the presence of coal particles reminds us that

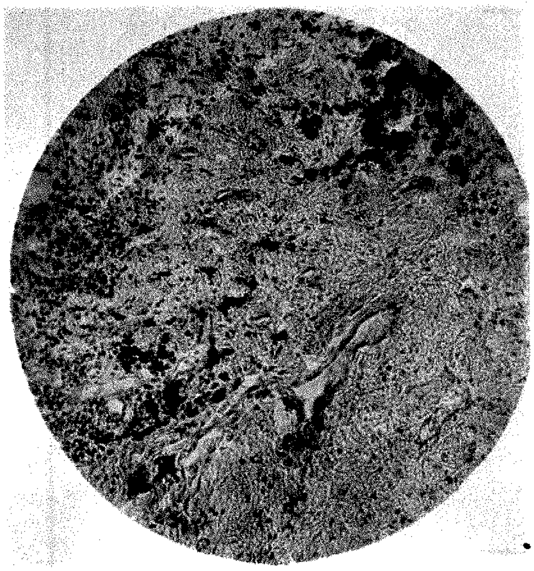

FIG. 34. Very extensive fibrosis of the lung. Practically the whole lung is replaced by a dense connective tissue. There is complete destruction of the lung parenchyma. Only the presence of coal particles reminds us that the tissue is that of an entirely destroyed lung tissue.

we have to do with an entirely destroyed lung tissue. The roentgenographic appearance of such an advanced fibrosis is identical with that encountered in other pathological conditions, especially fibrosis after pneumonia. Indeed, there is a striking similarity between these two processes. Thus, it is generally known that in individuals whose resistance is lowered and especially where there is a tendency toward inflammation of the lungs (locus minoris resistentiae), a fibroblastic invasion may follow a croupous pneumonia rather than a leucocytic invasion, and if such a patient develops two or three subsequent attacks of croupous pneumonia (probably because of the locus minoris resistentiae) extensive fibrosis of the lungs follows, absolutely identical with the condition described above.

TECHNIQUE

Local Treatment. When treating malignant metastases of the lungs, it is necessary to use a technique that will destroy the tumor tissues, and yet not damage the normal lung tissues. It is extremely difficult, if not impossible, to calculate exactly a physical dose (estimated in the water-phantom) which would fulfill these conditions, for the absorptive conditions in lungs involved by metastatic tumors are so complex that no exact conclusions can be drawn regarding the measurements. The normal lung contains air and consequently its permeability is higher than that of other tissues. By using the absorption charts as applied for the remainder of the body, an overdosage will be given which in turn, as shown above, will result in permanent damage to the lung tissue. On the other hand, if the lung tissue is filled with scattered metastatic tumor masses, its permeability toward radiation is decreased, and by using the absorption charts as arranged for the normal lung tissue, the tumor masses will be underdosed. Furthermore, considering that repetition of the treatment is liable to produce severe changes in the normal lung tissue, it is extremely important that the dose necessary to the tumor mass should be given in a single series. From our experience in the treatment of malignant tumors in other parts of the body, we do not believe that a standard so-called lethal sarcoma or carcinoma dose exists—we can speak only of optimum doses, which have to be repeated at due intervals. On the other hand, in treating lesions of the lungs, we had to attempt to give the maximum physical dose possible in a single series in order to avoid repetition of the treatment. This being the case, we did not try to estimate a standard biological dose for each tumor growth, but merely administered a physical dose which would be tolerated by the normal lung tissue, without producing secondary changes. This dose was estimated at 90 to 100 per cent S. E. D., as measured in the water-phantom. For the normal lung tissue this may reach from 120 to 130 per cent S. E. D., but for lungs infiltrated by the metastatic masses, the effective dose will be somewhere between 100 and 130 per cent S. E. D. We project this dose into the lesion as a non-concentrated massive dose, i.e., in contrast to the massive dose concentrated in one sitting (even for ten to twenty hours' uninterrupted exposure), we prefer to spread the administration of the dose over several days giving only four to six hours' exposure each day, which gives the patient ample time to recover from the effect of each individual treatment. However, we never spread the administration of the treatments over a period of more than a week. We cross-fire the lesion from different directions. Because of the higher absorption coefficient of the mediastinum and of the hilus, as compared with that of the lung parenchyma, we usually like to rotate the patients 45°, using large portals of entry from the front and back for each lung and if necessary, from the side. In this way, if the periphery of the lungs is cross-fired, for example, from two portals of entry, the mediastinum and the hilus, owing to the angulation, will be cross-fired from four portals of entry, and a sufficient dose will be administered to these tissues. By using this technique, we were able in the majority of cases to eradicate completely the lesion in a single course, and at the same time to protect the normal lung tissue from any serious damage. Indeed, the majority of our patients, successfully treated, were able to resume their work shortly after the treatment without showing any respiratory disturbances. Only in a few cases was it necessary to repeat the treatment.

The factors used in the treatment are as follows: 200,000 volts (peak) with 1.3 mm. Cu. and 1 mm. Al. as filters; S. T. D. varying from 40 to 60 cm.—large portals of entry. The effective wave-length of the rays produced under these conditions was λ eff. = 0.137 Å. u.

2. *General Treatment.* It is now generally recognized that in addition to the local effect of the roentgen rays upon the tumor mass, there is also a general effect from the reacting defense system of the body. Whether this is purely an antitoxic effect or whether it is a blood reaction as manifested by phagocytosis, we do not yet know. Recent experiments on animals by different authors undoubtedly prove that a tumor immunity exists. Until this question is put on a more solid basis, we have to explain the effects upon the broad general ground of stimulation of the protective forces of the organism. Stimulating irradiation of the spleen at repeated intervals, hypodermoclyses of saline solution following treatments, intravenous injection of electroferrol in the postradiative period, prolonged use of iron and arsenic preparations, are now indispensable parts of successful deep roentgen treatment.

PROGNOSIS

Our observations are limited to a period of one and one-half years. Consequently, no statement can be made regarding the final outcome of these diseases. Up to the present time, it was generally accepted that after a sarcoma or any other malignant tumor had metastasized to the lungs, the metastases were already spread to other parts of the body, so that even if the lung metastases were arrested, the patient would die as a consequence of the other metastases. Indeed, it has frequently been demonstrated that single cells of certain sarcomatous types are able to pass through the pulmonary capillaries into the general blood circulation and thus produce a generalization of the metastatic process in the whole body. Notwithstanding these facts, several of our patients, after successful treatment of the primary lesion and of the metastatic process in the lungs, have returned to normal health and have shown, up to the present time, a period of over a year, no signs of other metastases. This certainly is an accomplishment never expected before. We do not know anything about sarcoma or carcinoma immunity; consequently, we would not attempt to submit any theoretical explanations, but it is possible that the breaking down of the tumor cells by heavy irradiation may produce sufficient antibodies to enable the protective forces of the organism to take care of the few embolic cells left in the blood circulation or already spread to other organs of the body, and thus completely and permanently eradicate the disease. It is interesting to note, in this connection, that none of our seven cases of lymphosarcomata treated by an heroic irradiation of the whole lymphatic system has shown any signs of recurrence or of further metastases over a period of one to one-and-one-half years, although at the time of the treatment there was, in the majority of the cases, a very extensive involvement of practically all the lymphatic glands. We are convinced that we have in our hands a new weapon which the future will teach us how to use.

SUMMARY

1. Deep roentgen therapy is indicated in all metastatic malignancies of the chest where there are no metastases to be demonstrated in the remainder of the body.

2. While the tumor tissues as a rule show a decreasing sensitiveness toward repeated irradiation, the normal lung tissue itself shows an increasing sensitiveness.

3. In the treatment of metastatic sarcomata, the morphological and the histogenetic structure of the tumor play a very important part. Best results are obtained in the embryonal type of sarcomatas (angiosarcomata) while the fibroblastic, adult type of tumors, especially when rich in paraplastic structures, are refractory to radiation. The nearer the sarcomata come to the undifferentiated embryonal type, the better the chance for success, and the nearer they are to the adult

tumors, rich in paraplastic structure, the less the chance for success.

4. In the treatment of metastatic carcinomata, the circumscribed mediastinal metastases and the infiltrating lymphangetic metastases respond well to treatment, especially when the primary carcinoma is of the differentiated type. The miliary metastases of the carcinomata, if localized, respond well to the treatment, but if they are generalized, the prognosis is very grave.

5. Complications may arise incident to the treatment of all metastatic processes of the lungs: (*a*) hemorrhage of the lungs; (*b*) rupture of the lung, with following pneumothorax; (*c*) changes in the normal lung tissue.

6. If the dosage is not exceeded or if there is only one exposure, the lung changes are of only temporary character, that is, infiltration of the lungs; but, if the dosage is exceeded, and the irradiation is several times repeated, the changes may be permanent fibrosis of the lungs.

7. When treating malignant metastases of the lungs, the necessary biological dosage of radiation should be administered to the tumor tissue itself, but, at the same time, the normal lung tissue should be protected from all damaging results from the radiation. Therefore, attempt should be made to eradicate the disease in one single treatment. Only if this is impossible should the treatment be repeated. Never should a third or fourth irradiation be applied to both lung fields.

8. General stimulation of the protective forces of the organism should be an indispensable part of deep roentgen treatment.

9. No statement can be made regarding the final outcome of these diseases, our observations being limited to a period of one and one-half years.

10. The question of a sarcoma or carcinoma immunity is seriously to be considered. The future application of deep roentgenotherapy will probably develop along these lines.

NOTE.—We are indebted to Dr. P. F. Morse, Chief Pathologist for Harper Hospital and Dr. C. W. Halliday, of the Surgical Staff, for autopsy and pathological assistance.

HIGH-VOLTAGE TREATMENT IN A SERIES OF SARCOMA CASES*

BY W. S. LAWRENCE, M.D.

Medical Department of the University of Tennessee

MEMPHIS, TENNESSEE

IN THE field of deep therapy today we occupy a position not entirely unlike that held in the field of superficial therapy some fifteen years ago. At that time we knew that we had come into possession of a most remarkable therapeutic agent, an agent which at times produced results little short of marvelous. By its use many diseases and conditions formerly thought to be hopeless were brought into the classification of "probably curable." There was at that time the greatest possible variation in the matter of technique. Hardly any two men were doing the same thing in the same way. All knew a good method of application, but none knew the best method.

And so today those of us who have had a considerable experience in the newer deep therapy are fully convinced that we have a method of application of radiant energy which is far superior to the older method, and that this method will give results that formerly were not obtained. In general, most of us are pleased with results that can be gotten. Some of us have seen a few cases resulting in cures beyond the wildest dreams of optimism. All of us have seen failures. All of us have seen cases that we thought would do well, but that did poorly enough; and those we thought hopeless we have seen recover.

Tumors that look alike to the unaided eye and to the microscope do not always react alike to a given method of treatment. There is still much to be desired in the matter of case classification and prognosis.

Our instruments of measurement have reached today a high degree of precision, and there is a far greater degree of unanimity of opinion in matters of technique than ever before, but there is yet much to be agreed upon.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

It is easy to determine the dosage a given case *has* received, but it is difficult to determine the dosage it *should have received*. Some of us who readily take to rule-of-thumb methods believe that there is such a thing as a "carcinoma dose," but most of us doubt it. Some of us believe that the whole dose, whatever we determine that to be, should be given at one time; others believe that this total amount should be split up into daily doses of about one hour each. Some believe that all that can be accomplished is accomplished at the first treatment, or series of treatments, while others hold that the initial amount may be repeated several times with benefit, or hope of benefit. Again, some say that the initial amount may be repeated within a month, while others maintain that the dose should not be repeated until the lapse of two, three, four or even six months.

In view of these existing differences of opinion I think that some good may be derived from reporting cases, or series of cases, treated by a given technique, however far that technique may be from what we finally settle upon as nearest the ideal.

The nearest I have to a fixed idea in matters of technique is this: that in future we will use less filtration rather than more, and that we will depend more upon distance to improve the surface-depth ratio of dosage. The use of 1 mm. of copper instead of ½ mm. adds very greatly to the time and expense of the treatment, for a comparatively small increase in the depth-surface ratio. This loss in depth dose can easily be overcome by using one more port of entry. From the patient's standpoint it makes the treatment a very much less trying ordeal. I venture to predict that filtration will eventually settle down to somewhere near ½ mm. of copper—possibly 4/10 mm.—and that the now customary 50 cm. distance will be somewhat increased.

In the series of cases about to be reported the filtration used was ½ mm. of copper with the customary 1 mm. of aluminum. The distance was 50 cm. and the current, 5 ma. The total amount given at each series was divided into daily hours. The voltage was varied from 170 to 200 kv., roughly in proportion to the depth of the lesion below the surface.

CASE I. Aged thirty-one, tenant farmer. Admitted to the General Hospital, Sept. 13, 1922, complaining of pain, swelling, and marked exophthalmos of three weeks' duration in region of left orbit. Tissue from a tumor over the left frontal sinus was removed for diagnostic purposes. The pathologist reported "large round-cell sarcoma." The patient was discharged Sept. 24th with a diagnosis of inoperable sarcoma involving the nose and the whole of left orbital region.

On Oct. 5th, shortly after my deep-therapy machine was installed, I agreed to try this apparently hopeless case. At that time there had been very rapid growth of all the nodular masses surrounding the left eye. In spite of the marked exophthalmos the eye was entirely hidden from view. The patient received a treatment of 450 ma. min., one-half laterally and one-half anteriorly, voltage only 170 kv., and was told to return in three weeks. The patient, however, presented himself again on the twelfth day after the treatment, with both eyes wide open, no exophthalmos, no swelling, and with practically every trace of the disease gone. At this time I gave him 300 ma. min., divided as before.

Four months later this patient had gained 30 lbs. and appeared to be in perfect physical condition, and such is his condition today. The striking features in this case are the marked susceptibility of the growth and the great rapidity of improvement.

CASE II. Female, aged thirty-three. This case bears a striking resemblance to Case I, the chief difference being that in this case the onset was much more gradual and the tumor growth very much slower. She was first seen by Dr. W. L. Simpson, Dec. 26, 1922. At that time there was swelling of right side of face and right eye which she stated was of eight months' duration. From Dr. Simpson's case notes it appears that the patient had a negative Wassermann, that the swelling of the face gradually increased, that a tumor about the size of a hickory nut appeared just external to the last two upper molars on the right side, and that the exophthalmos became very marked. On March 17, 1923, the growth was removed by way of the mouth. The tumor removed was the size of a walnut, not encapsulated and not attached to the bone. Pathologist's report: "round-cell sarcoma." The patient was referred to me for roentgen therapy, and on March 26, 1923, was given 200 ma. min. through an anterior exposure. The following day she was given 300 ma. min. through a lateral exposure, voltage in each case being 175 kv. She was next seen on April 10th, at which time the exophthalmos, the swelling about the eye and all signs of the tumor had disappeared. The pain and feeling of tension had also subsided. She was given at this time 200 ma. min. through a lateral exposure, and 100 ma. min. on April 20th, though I could see no indication for it. This patient was last seen by me on August 10th, four and one-half months from the date of the first treatment, and was apparently in perfect condition. She had gained 25 lbs. in weight. Dr. Ellett examined her at that time and reported everything in the region of the eye normal.

CASE III. Female, aged fifty-five, referred by Dr. E. M. Holder. Abbreviating from Dr. Holder's case history we find, Jan. 12, 1911, cystic tumor growing from both ovaries almost filling abdomen. Inside, the sac of tumors presented a soft cauliflower appearance. A panhysterectomy was done. Pathologist reported the tumors to be sarcoma. Continuing Dr. Holder's case history we find, eleven years later, on Sept. 22, 1922: patient has enjoyed good health until past two years; for that period she has had some pain in abdomen. A week ago she noticed a discharge from navel which is viscid and malodorous. She has lost some weight.

Physical Examination. A mass about the size of a large dinner plate seems completely fixed in anterior abdominal wall. Mass is flat from before backward and is probably four inches in thickness. Navel purplish in color, bulging and discharging a viscid and offensive fluid.

Diagnosis. An inoperable malignant growth, the nature of which cannot be determined without section.

This patient was referred to me for treatment Sept. 25, 1922, before my high-voltage machine was installed. From Sept. 25th to 30th she was given full skin tolerance doses through three fields, anterior, and right and left lateral, with a current of 110 kv., distance of 14 in. and with 4 mm. of aluminum filter. Three weeks later the skin was somewhat tanned, but there was very slight, if any, improvement in the size of the growth. From Oct. 20, 1922, to Feb. 22, 1923, she received a total of 3250 ma. min., divided about equally into four series of treatments. In each series were three treatments, one anterior and two lateral, the factors in each case being 175 kv., ½ mm. Cu. and 1 mm. Al. filter, and 20 in. distance.

The patient came for examination April 29, and appeared to be entirely well. I saw her again on Sept. 4, 1923. At that time Dr. Holder, who had referred the patient, examined her with me. Neither of us could find any trace of the tumor which had one year ago been incorporated in the whole anterior abdominal wall. The navel is deep, dry, and healthy in appearance. The patient has regained all of her 20 lbs. of lost weight, and is symptomatically well. The skin is practically normal in appearance.

A feature of interest in this case is that this growth seemed to be resistant to skin tolerance doses of low voltage, and began to improve promptly on less than skin tolerance doses of high voltage.

CASE IV. This case, having all the clinical signs and symptoms as well as radiographic evidence of an advanced lymphosarcoma of the mediastinum, was reported in detail at the February meeting of the *x*-ray section of the Southern Medical Association. At that time the patient had been symptomatically well for about six months. The fact that an additional seven months have now passed, during which time the patient has remained perfectly well, is my reason for making this supplementary report. No treatment has been given for about one year. A letter from the patient a few days ago stated that so far as he could tell he was in perfect health.

This case began treatment on low voltage, and improvement was rapid, as it always has been in similar cases. High voltage was used in the later treatments. Since this patient, a man of twenty-nine years, has remained well without treatment far longer than the average case of lymphosarcoma of the mediastinum, it has occurred to me that possibly the more penetrating rays were able to reach in lethal dosage the deeper-seated portions of the tumor, whereas in those cases treated by low voltage the more remote parts of the tumor were sufficiently protected to remain alive and later to spring into activity, causing a regrowth of the tumor.

DISCUSSION[1]

Dr. D. Y. Keith, Louisville. In reference to the sarcomas that Dr. Lawrence reported, I am sure all of us have had similar experiences. Most of those of the type that he has shown respond very quickly to radiation. He has shown unquestionably that the higher voltages will reach tumors situated deeper in the body than voltage of 110 or thereabouts, but in the pelvic case that he reports, which did not respond to radiation of 110 volts with a filter of 4 mm. of aluminum and which did respond later with higher voltage and filtration, I can see no reason for attributing the result to the higher voltage. Occasionally we see cases of this kind that do respond to the second application more than they do to the first. I am sure all of us have seen this in our older therapy with the lower voltages.

I believe we should all be very careful about filtration. I believe also that we are going to learn more in the treatment of neoplasms, whether it be sarcoma, or carcinoma by being real clinicians, and we will all have an idea as to which filtration will be better for certain types of tumors. I am positive that filtration means as much to us as voltage. We showed before the Central Section of this Society at St. Louis two years ago in February a series of carcinoma that had remained well three and a half, and one for five years, after treatments. I would like to say that those patients are all still alive. Some of them were considered inoperable before we saw them and are absolutely free of symptoms at present. That is with the lower voltage, and given over three, four or five series, and the patient observed for at least six or nine months' time, coming in usually at the end of a month for the first series, six weeks later for the second, and then coming every three or four months. By keeping track of them that way for a year or more we can learn more about filtration.

In regard to Dr. Evans' paper, he has very definitely shown, as was indicated yesterday, that there is a limit to radiation of any tissue and that we can do a great deal of harm by too much radiation. A very interesting point that he brought out is that we unquestionably have certain classes of tumors that do not respond to radiation. He spoke particularly of metastasis from bone sarcoma. I believe he failed to state whether or not the primary tumor had been rayed, and whether or not it showed any response. Some of you have seen in the exhibit our plates of a periosteal sarcoma. This tumor was rayed heavily with high voltage because the patient's physician insisted on its being rayed before operation, as he had had a few cases that had shown good results, a very brilliant result being obtained in one case. This patient had very definite relief from her pain; there was no change whatever that we could see in the tumor except evidence of a little more calcification than in the films made before treatment. She died with a cerebral embolism after operation. I am sure if she had lived long enough and had had metastases, we would have found the same condition true—that they would not have reacted to radiation.

Dr. H. J. Ullmann, Santa Barbara, Calif. I wish to add a little point to the question of the treatment of sarcoma. I have had the opportunity to see 3 cases of lymphosarcoma in men all close to or over seventy years of age, one just under seventy, one seventy-eight, and one over eighty. We never were able to make a biopsy on the youngest of the three. He had large masses on each side of the neck. The clinical diagnosis of the surgeon was lymphosarcoma. He had had treatment with long-wave therapy with divided doses, at one week intervals, without any change. That is rather unusual, because we expect lymphosarcomas to respond rather readily to radiation. I gave him one series over the lungs, for he had some mediastinal shadows, and one series over the neck masses as soon as the reaction from the fractional dosage had subsided. There was no response whatever in the size of the tumors in the neck, but there was a drop in the temperature which he had been running. Unfortunately, we were unable to follow this case, because he became discouraged within three or four weeks of the radiation, not having had immediate response, and shot himself.

The second case was a man I think eighty-six years of age, with glands in the neck, the axilla, and the mediastinum. He responded very well to the first series, none of which were really massive doses. In about eight weeks they began to grow again and he received another series. He received still a third series, and the masses were going down nicely, and his condition seemed to be very good, when he began to run down like a clock. I mean by that that his temperature began to fall, his pulse-rate began to fall, while still remaining good, and he died, as far as the clinical evidences indicate, an old-age death. Unquestionably it was hurried by his radiation and his tumor. We had an autopsy and found nephritis, bronchial asthma, and a few other things in addition to the trouble in his neck. The masses in the neck and the axilla had been replaced practically entirely by connective tissue, distinctly healing. Those in the mediastinum were going through the same course, but to a lesser degree.

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[1] This discussion has reference to the preceding paper by Drs. Evans and Leucutia, as well as to the above.

The third case was a man seventy-eight years old who developed glands in the neck, as his physician said, and he lanced them. I urge those of you who have never seen a lanced lymphosarcoma, not to do it. He was then brought in for radiation. At that time he had large masses on the right side of the neck which were draining, smaller masses on the left side, masses in both axillae, both groins, and epitrochlear regions. Biopsy on the groin mass was reported lymphosarcoma. He was given his first course of radiation, and with the exception of the glands in the neck which had been lanced, all the masses simply melted away.

An interesting point is that the epitrochlear glands disappeared at the same time, although they were not rayed. The area that had been opened continued to open itself wider and wider. Muscles broke down, blood vessels broke down and sloughed out until he had an opening in the side of his neck one could almost put a fist in. So that area alone was given a very large dose through only ¼ mm. of copper, and immediately began to heal. It was healing beautifully, the masses had disappeared, the skin was filling in, when he was chilled driving in from his ranch about 120 miles away, developed pneumonia and died.

We obtained a limited autopsy; that is, we were allowed to remove specimens from the defect on the side of the neck. I have not had a microscopic report as yet, but cutting them was like cutting cartilage. Even the muscles overlying the enlarged glands felt fibrous to the knife, and there were no enlarged glands to be found. There were a few small ones about normal size in the depth. I report these because of the marked fibrotic changes, and the one case that failed to respond.

Dr. A. C. Christie, Washington. I would like to speak very briefly about these lung changes that Dr. Evans mentioned in his paper. Just a year ago at the Los Angeles meeting my associates and I reported a number of cases in which we had observed marked lung changes after treatment of the breast and of other lesions about the chest. We believed then, and are fully convinced now, as I think everyone is, that there is a very definite limit to the amount of radiation which we can use over the chest without getting permanent and sometimes very serious changes in the lungs.

I think these slides of Dr. Evans' not only prove very definitely that there are permanent changes produced in the lung by radiation, but show quite conclusively the cause of the changes.

Previous to about eighteen months ago nearly everyone believed that all these changes were due to the extension of the carcinoma, but I think it is definitely proven now that they are the result of radiation, and it shows that there is a very definite limitation to the amount of roentgen ray that we can use over the chest without doing permanent damage to the lungs. Dr. Evans has shown quite definitely what these changes are; that they begin with an infiltration and finally result in a very extensive fibrosis, not only in the lung itself, but in the pleura. It was noticeable on the slides that the lung that received the most radiation was very much retracted—it was much smaller usually than the lung that received the lesser amount of radiation—due to the extensive fibrosis through it, the retraction of the heart and the great thickening of the pleura on that side.

The one slide that Dr. Evans showed in which there were carcinomatous cells incarcerated in the mass of fibrous tissue is a suggestive thing, because we know that that takes place in other regions where carcinoma is treated. It suggests the inadvisability of operating on a carcinoma that was originally considered inoperable and that has undergone retrogression under roentgenotherapy. The carcinoma cells that are incarcerated may be liberated and cause metastases.

Dr. Lawrence (closing). I was so much impressed with the rapidity of the action of the ray in the first 2 cases that I recorded it.

The first young man had not been able to open his eye on acount of the generalized swelling about it, had not been able to see for a month, and twelve days after treatment he walked into my office seeing perfectly with both eyes.

The other patient, as I have mentioned, said that every distressing symptom was gone in six days after the first treatment, and the swelling was all gone in fourteen days when she came for the second treatment.

TUBERCULOUS LOBAR PNEUMONIA (PNEUMONIC CASEOUS TUBERCULOSIS)*

BY L. R. SANTE, M.D.

Department of Roentgenology, City Hospitals No. 1 and No. 2

ST. LOUIS, MISSOURI

IN recent years the practice of roentgenographing acute inflammatory processes of the lungs has given us much information as to the mode of onset, character, and course of this group of diseases, and has brought to our attention many conditions of obscure nature. In a study of lobar pneumonia recently undertaken[1] an occasional case was encountered having symptoms of lobar pneumonia and a corresponding roentgenographic picture of lobar consolidation, but which ran a more protracted course and was ultimately proven to be of tuberculous origin. In the last four years 13 cases have been encountered which could be established as undoubtedly of this type.

The clinical course of these cases varied from that seen in true lobar pneumonia of uncomplicated inflammatory origin. The onset may be sudden, with chills or chilly sensations, followed by high temperature, rapid respiration and pain in the chest. As a general rule, however, patients affected with this type of tuberculous pneumonic involvement do not present the same critical picture as true lobar pneumonia. The respiration is rapid but not to the degree of dyspnea attained in inflammatory cases. The leucocyte count may be high, but never, in our experience, has it attained the proportions encountered in pneumococcus lobar pneumonia. The sputum is tenacious and yellow, often streaked with blood; in none of our cases was it of the prune-juice type, although this type of sputum has been reported by others in connection with the disease. On the whole the patients do not appear so sick as individuals afflicted with pneumococcus lobar pneumonia. Not all cases are so acute. Many are of a much less severe nature and follow a more chronic course.

The site of the lesion has been chiefly in the upper lobes, one occurring in the left upper, one in the right upper and middle, and one involving the entire right side; the remainder were in the right upper lobe. This is in accord with the experience of others; a case of right middle-lobe involvement is mentioned by Assman[2]; lower lobe involvement is described by Osler[3] and massive involvement of an entire lung shown by Delafield and Prudden.[4]

Defervescence is by lysis and the temperature usually settles down to the septic type. The clinical course of pneumococcus pneumonia is so variable, however, that it is almost impossible at the beginning to make the differential diagnosis, and it is not until the time for crisis has passed that suspicion is aroused. Days and weeks pass and there is no clinical evidence of resolution of the consolidation, and the fever continues. The examination of the sputum discloses large numbers of tubercle bacilli and in this manner the true nature of the condition is determined. Roentgenographically considered, the consolidation, when at its height, resembles in all respects that of lobar pneumonia. Dense consolidation is seen, confined to one or more lobes, often with a relatively small amount of involvement elsewhere in the chest. The exact method of invasion of the process cannot be indicated with certainty, no case having been observed where the consolidation, starting at a single point, advanced to involve an entire lobe. In 2 cases of our series the consolidation was first noted in the hilus region from which the process extended out along the lower border of the upper lobe, suggesting that this may be the method of advancement of the lesion. None of the cases observed, however, went on to complete consolidation of the entire lobe. After rest in bed, the acute process subsided in both of these cases within a few weeks. The condition seems prone to occur in locations previously the site of mild tuberculous involvement. Two of our cases, which were of this type, had previously been under observation for mild tuberculous lesions (incipient tuberculosis); the

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18-21, 1923.

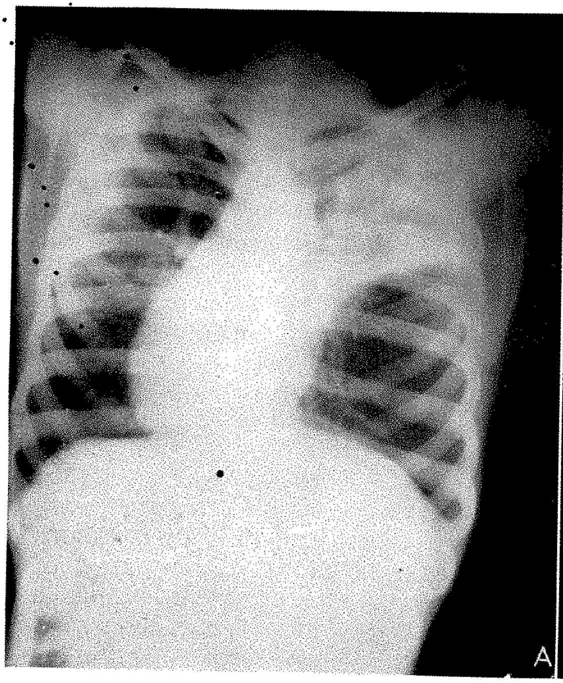

FIG. 1a. Acute pneumonic tuberculosis of lobar type, involving right upper lobe. Little if any involvement elsewhere in the chest. The condition was considered lobar pneumonia until failure of resolution and continuance of fever indicated the true nature of the disease.

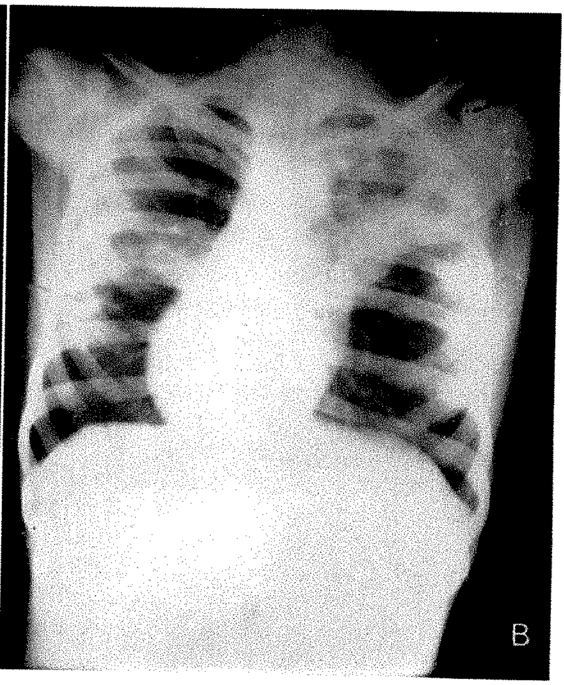

FIG. 1b. About three months later some resolution has occurred and beginning cavity formation is apparent. Tubercle bacilli were found in the sputum in large numbers.

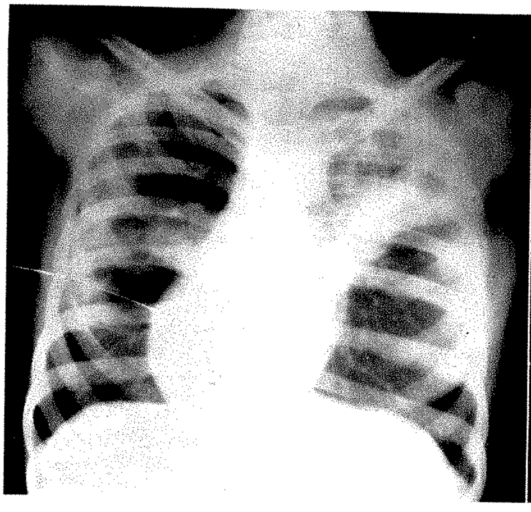

FIG. 1c. Still further resolution some time later.

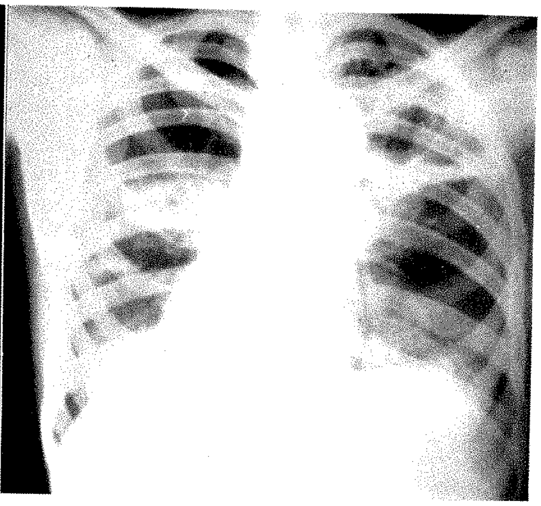

FIG. 1d. Almost complete disappearance of the consolidation, but numerous large cavities are present and there is evidence of fibrosis. The entire process required about six months. There appears to be an increasing infiltration at the opposite hilus. The condition was ultimately fatal.

acute lobar consolidation occurred at the site of the previous disease. This acute process seems prone to develop in individuals previously afflicted with tuberculous disease, who, by reason of their duties, are subjected to severe physical strain and long hours of work. Lesions which would not cause much concern in individuals in the ordinary walks of life may assume great proportions and should be viewed with greater concern when occurring in individuals whose pursuits demand long working

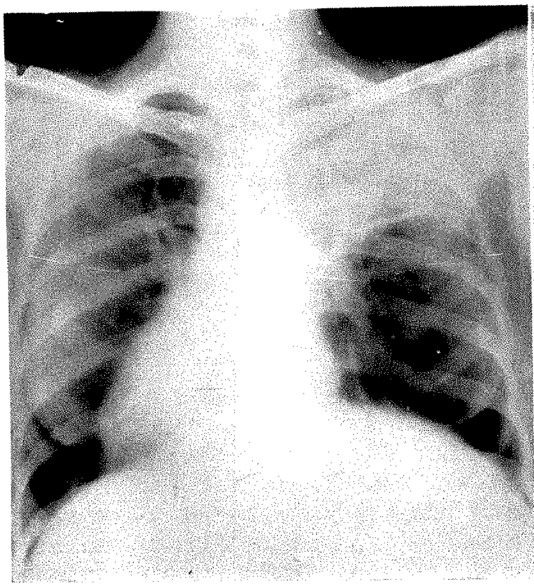

Fig. 2*a*. A case showing the lesion in the right upper lobe. Of 13 cases, 10 showed involvement of the right upper lobe.

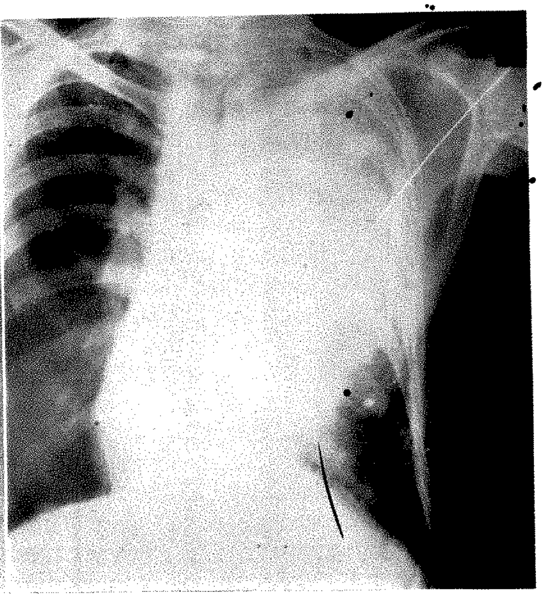

Fig. 2*b*. Involvement of the right upper and middle lobe.

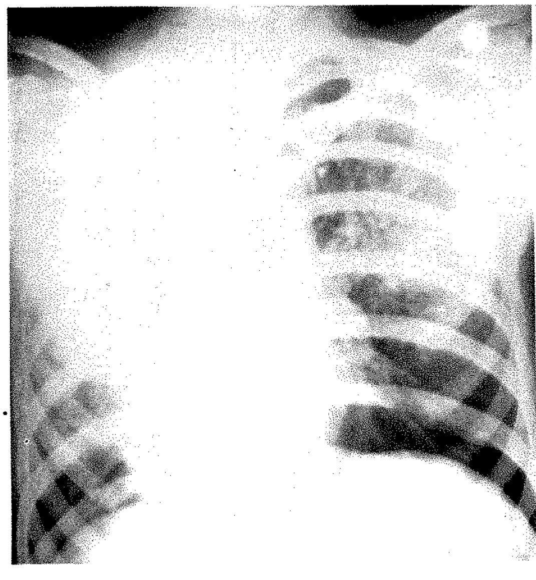

Fig. 2*c*. Involvement of the upper portion of the left lung. Within a short time the process spread to involve the entire left lung (Fig. 2*d*).

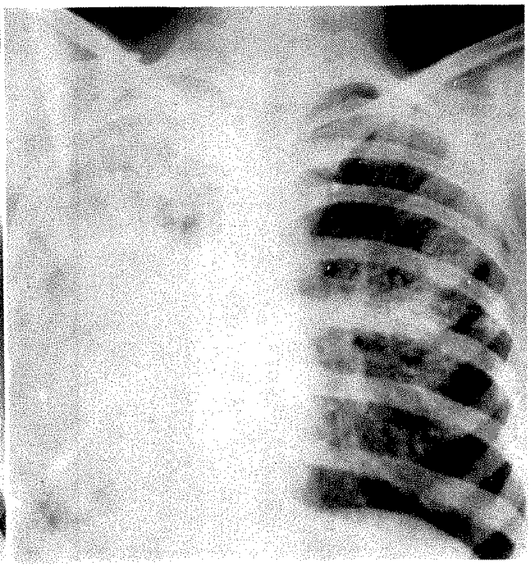

Fig. 2*d*. Complete involvement of left lung with beginning cavity formation.

hours and hard work. Nurses, for example, previously afflicted with what would seem a trivial lesion in individuals engaged in the ordinary pursuits of life, are especially prone to the development of this type of lesion owing to the character of their work.

Resolution of the consolidation requires several months. Weeks and even months may elapse without material change in its character. Gradually, however, the shadow, previously of more or less uniform density, becomes mottled and blotchy in appearance and there is evidence of cavity formation. Cavity formation has been the ultimate result in all but one of our cases. The cavities are usually multiple, well-defined, and occasionally become fibrosed. With a single exception the mark of the lesion remained, and even in the more favorable cases there was never complete resolution of the process.

Pathologically these cases represent a massive caseous tuberculous pneumonia with large areas of caseation and formation of ragged cavities. According to Delafield and Prudden[4] the tubercle bacillus causes three types of reaction in tissues; the production-type, causing the proliferation of connective tissue cells, and fibrous tissue formation; exudative type, causing migration of cells from the blood vessels and formation of exudate; and the necrotic type, resulting in destruction of tissue from the toxins of the microorganism. The exudative type is the type occurring here. A large part of the process is inflammatory in character and it is possible that the ultimate resolution of the greater part of the consolidation shadow represents an absorption of this inflammatory exudate. Prudden has shown, however, that the tubercle bacillus alone can give rise to this exudate and that the associated infection by pyogenic microorganisms is not necessary. A review of the literature reveals that acute pneumonic types of tuberculosis have been known for a long time and were described long before the x-ray was discovered. Many years ago an acute form of tuberculous pneumonia was recognized which simulated, at the onset, lobar pneumonia, but which failed to run the same clinical course. Osler[3] describes this pneumonic type of tuberculosis as follows: "In the pneumonic form one lobe may be involved, or in some instances an entire lung. The organ is heavy, the affected portion airless, the pleura is usually covered with a thin exudate and on section the picture resembles closely that of ordinary hepatization. . . . There may be smaller areas which are of peculiar yellowish-white color and distinctly caseous. The most remarkable picture is presented by cases of this kind in which the disease lasts for some months. A lobe, or an entire lung may be enlarged, firm, airless throughout and converted into a dry yellowish-white cheesy substance. Cases are met with in which the entire lung from apex to base is in this condition, with perhaps only a small narrow area of air-containing tissue on the margin. More commonly, if the case has lasted for two or three months, rapid softening has taken place at the apex with extensive cavity formation. Osler[3] reports a series of 15 cases, and quotes Frankel and Traje's[5] report of 12 cases.

While many cases are acute in onset and rapid in their course (Tendeloo reported a fatal case on the sixth day), more chronic cases are encountered where the disease lasts for four or five months, death ultimately being from asthenia. Cases have been mentioned in which the process was followed by fibrosis, the patient remaining alive for four or five years. From the roentgenographic evidence it seems probable that more of the acute exacerbations which occur during a tuberculous disease may be of this type—less extensive in involvement but essentially the same pathological process—which do not go on to this unhappy ending but which are ultimately fibrosed and arrested. It even seems probable that such acute lesions may not all result in cavity formation where the area involved is small.

The meager mention of this lesion in the literature from the roentgenographic standpoint, and its confusion with some of the more acute types of lung infection have prompted this presentation.

It would seem, from the small series of cases quoted by Osler and other authorities, that the condition is quite rare.

This of course was before the advent of roentgen examination. It must be remembered that the roentgen ray has more readily detected these cases and established the true character of the lesion, which in many instances must otherwise have remained in doubt. To determine the relative frequency of this type of tuberculous lesion, a study was made in 1922 of the first 1000 cases examined for tuberculosis among which there were only two cases which could unmistakably be labeled

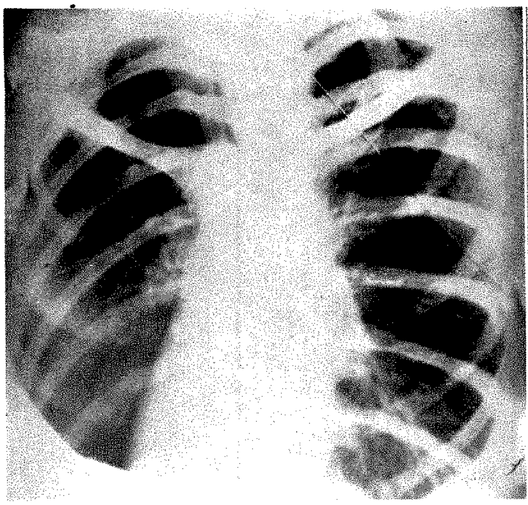

Fig. 3*a*. Peribronchial thickening and a few infiltrations in right apex. Symptoms were primarily of gastrointestinal nature and the patient was submitted for examination on this account.

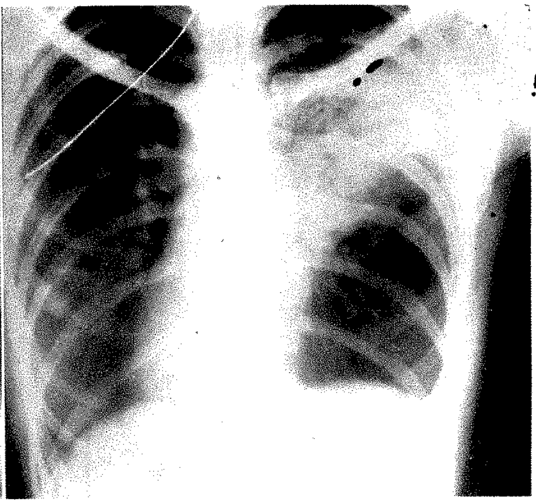

Fig. 3*b*. Same case, scarcely more than a month later, after an acute exacerbation, with high fever, dyspnea and pain in the chest. Note the consolidation of the lower portion of the upper lobe and its abrupt limitation to the upper lobe. Tubercle bacilli were abundant in the sputum at the height of the exacerbation; they were never detected before.

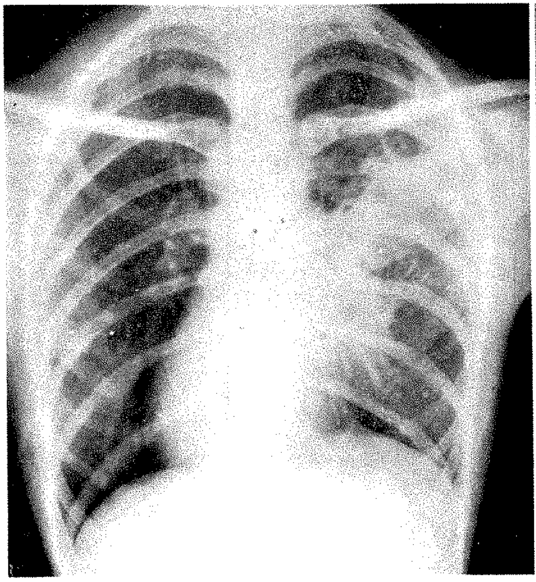

Fig. 3*c*. The condition sometime later after the subsidence of the acute symptoms. Note beginning cavity formation.

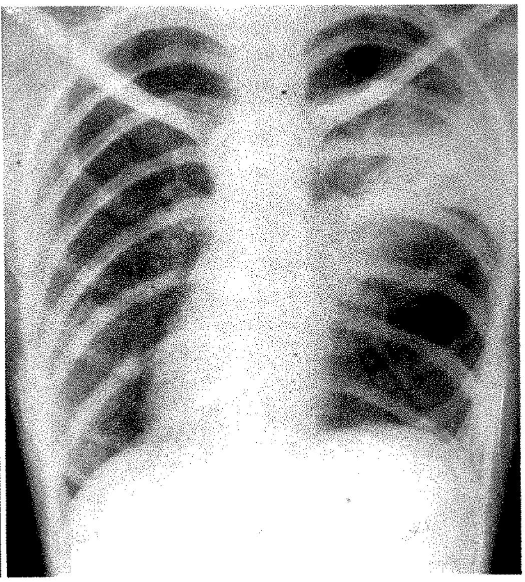

Fig. 3*d*. About one year later, showing fibrosis and definite cavity formation. The physical condition of the individual had so improved that she was permitted to resume her former duties.

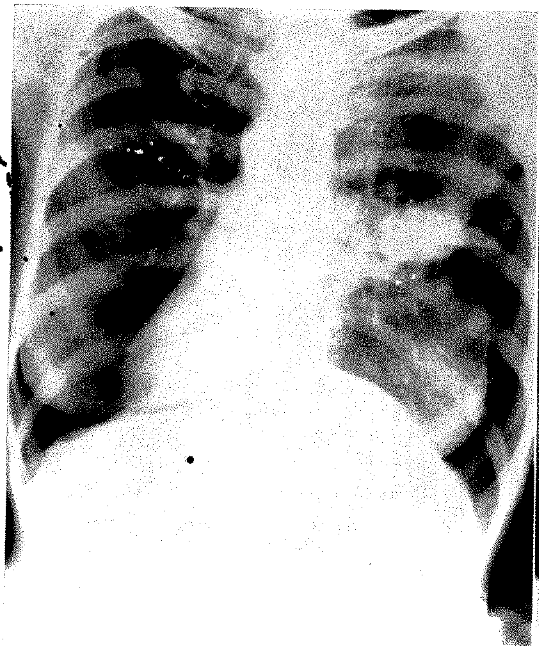

FIG. 4a. Acute consolidation in the right hilus with evidence of extension of the process outward through the lower portions of the upper lobe. Evidence of an old fibrosis of the upper lobe is also present.

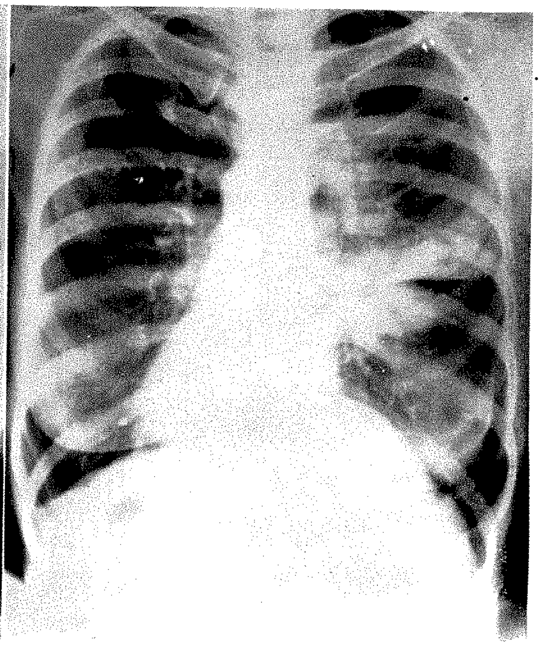

FIG. 4b. One week later showing definite extension of the process to the lower portion of the upper lobe.

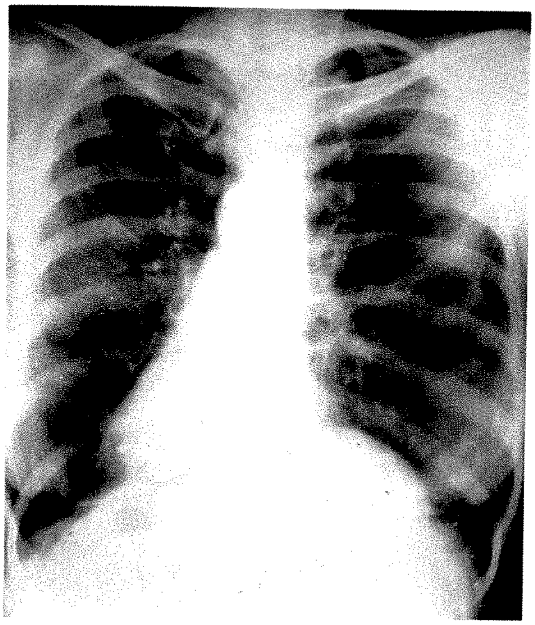

FIG. 4c. Six months later showing complete resolution of the process. It is possible that this might have been an atypical hilus pneumonia of inflammatory origin with a coexisting tuberculous infection.

as of this type. That this does not represent the true state of affairs, I am quite confident. Such a study is of little value and cannot bring to light the true number of instances of this condition. The difficulty arises in the lack of minute correlation of clinical and roentgenographic findings. Without the clinical history of an exacerbation in a tuberculous process and a roentgenographic knowledge of the condition before the exacerbation, any fresh areas of involvement appearing in the lung which might thus be established as of this acute type, would necessarily fail of recognition and be considered an ordinary advancement of the disease. There is no doubt that the massive lesion involving an entire lobe or lung is a rare condition but I feel quite confident that smaller areas of consolidation, similar in pathological process, do occur with comparative frequency in connection with acute exacerbations in an established tuberculous process. The true nature of the process will be demonstrated only as the value of serial roentgenographic examination of chest conditions becomes more generally appreciated.

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DISCUSSION

Dr. L. T. LeWald, New York. I think Dr. Sante's paper is really of great importance. It is a subject that has not been recorded much in roentgen literature but is well-known clinically. I think the differential diagnosis between croupous pneumonia and tuberculous pneumonia has not been drawn roentgenographically as it should be. I had two or three cases of tuberculous lobar pneumonia last year in general hospital work. The last case was very much along the line of the first case Dr. Sante showed, except that it went on to a complete consolidation of the entire right lung. Clinicians brought out the point that while the roentgen ray appearance might lead you to believe there was an ordinary pneumonia, the clinical evidence was very different, and the temperature not so high, and I think that point Dr. Sante has also made.

A ROENTGENOLOGIC STUDY OF BENIGN TUMORS OF THE STOMACH*

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THIS report is based on a study of the roentgenologic findings in 23 cases of benign tumors of the stomach in which operation was performed in the Mayo Clinic. In 1921 Eusterman and Senty reported in detail the clinical, surgical and pathologic findings in 27 proved cases of benign gastric tumors, and since then 6 additional cases have been studied, making a total of 33 cases. Roentgenologic examinations were made in 17 of the first series and in all 6 in the second series.

While the available literature contains many excellent reports of the roentgenologic findings in individual cases of benign gastric tumors, apparently no series of cases has been reviewed with the purpose of ascertaining whether there are roentgenologic characteristics, either typical or suggestive of the pathologic process. With this purpose in mind, the study here reported was undertaken.

The average age of the 23 patients (13 males and 10 females) was forty-four years and four months, the extremes being sixty-nine and eight years respectively.

The tumors were classified pathologically, as leiomyomas, two; adenomyomas, two; fibromyomas, four; simple myomas three; fibromyomas, three; dermoid, one hemangiomas, five; polyposis, two and a single polypus, one. In more than half of the cases, superficial ulceration was found.

The growth was located in the cardiac end of the stomach in 2 cases; in the middle portion of the stomach in 7; and in the pyloric portion in 12. In one of the cases of polyposis, practically the entire stomach was involved, while in the other, the lesions were localized to the lower two-thirds. The lesion was on the posterior wall in 9 cases, on the anterior wall in 7, on both walls in 2, and on the greater curvature in 2; the exact location was not mentioned in 3 cases. These tumors varied in size from a large dermoid, weighing 1,000 gm. to a very small polypus about 2 cm. in diameter.

As has been pointed out, benign gastric tumors do not present definite, characteristic syndromes. However, the cases have been grouped from the standpoint of the clinical history and the type of complaint. In 5 cases the complaint simulated carcinoma of the stomach; that is, there was a history of loss of weight with more or less digestive disturbance and anemia. In 4 cases a definite history of primary digestive trouble, simulating that of ulcer, was elicited. In 10 cases the trouble was extremely indefinite; in 4 cases the principal, and practically only complaint was that of hemorrhage from the gastrointestinal tract. Eleven patients had had either melena or hematemesis. In 1 case, a leiomyoma at the cardia, there was a history of dysphagia and regurgitation of food. Gastric retention was noted in 3 cases; these also revealed a six-hour retention following the barium motor meal. In but 4 cases was a palpable mass discovered. The roentgenologic findings were:

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* Read at the Annual Twenty-fourth Meeting of The American Roentgen Ray Society, Chicago, Ill., Sept. 18–21, 1923.

1. "Obstruction at the cardia with diffuse dilatation of the esophagus." This proved to be a leiomyoma in the cardiac end of the stomach, producing marked obstruction of the lower esophagus.

2. "A filling defect in the pyloric end of the stomach, unusual in appearance." At operation a fibromyoma was found, attached to the posterior wall in the pyloric end of the stomach, the attachment being so pedunculated that it permitted a prolapse of the tumor into the duodenum.

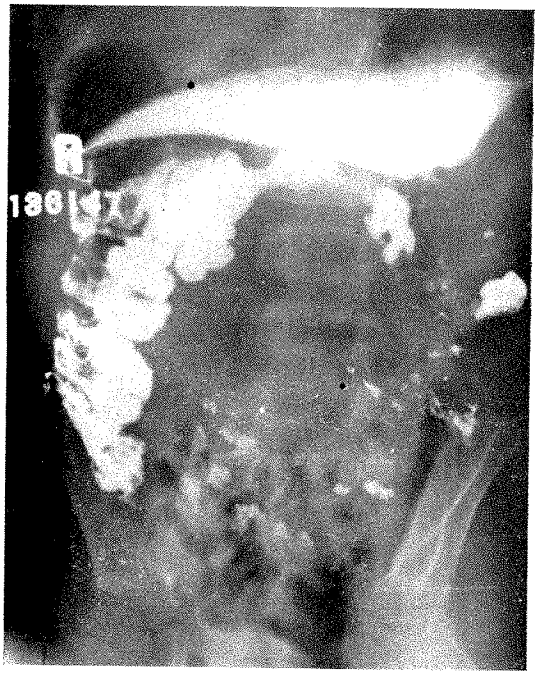

Fig. 1 (Case A136147). A large dermoid attached to the posterior wall, displacing the stomach upward.

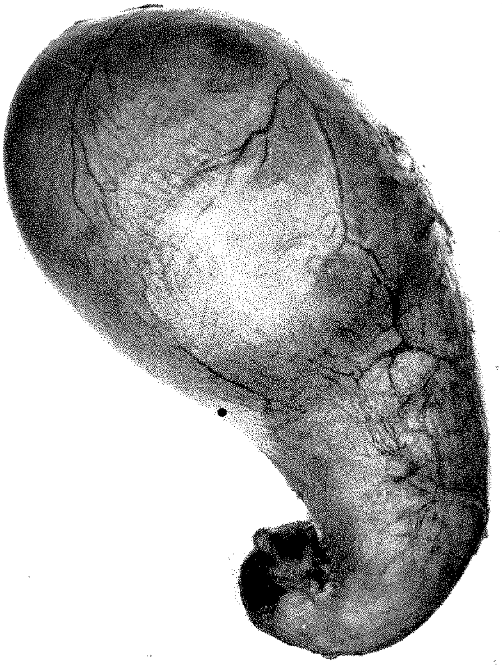

Fig. 2. Gross specimen of case shown in Figure 1.

3. "A filling defect in the pyloric end of the stomach, either cancer or syphilis." This was a fibroma in the pyloric end of the stomach, producing marked obstruction.

4. "Lesion in the pyloric end of the stomach." This was a large fibroma (3 by 25 cm.) in the pyloric end of the stomach.

5. "Lesion at the outlet of the stomach" (2 cases). In 1 case there was a small fibromyoma on the anterior wall near the pylorus; about 7.5 cm. above the tumor was a fairly deep perforated gastric ulcer. In the other case there were multiple myomas on the posterior wall near the pylorus. In both cases there was a six-hour retention with pyloric deformity.

6. "Cancer of the stomach" (2 cases). In each of these cases there was a hemangioma on the anterior wall in the middle portion of the stomach. One tumor was pedunculated, the other closely adherent to the mucosa, and both produced smooth filling defects, deforming slightly, but not encroaching on the lesser curvature.

7. "Perforated ulcer on the lesser curvature of the stomach." At operation the ulcer was found, and also a small adenomyoma on the posterior wall near the pylorus.

8. "Stomach deformed and displaced upward; no obstruction to barium meal." Operation revealed a large dermoid, weighing 1,000 gm. and attached to the musculature of the posterior wall of the stomach, but not encroaching on its lumen.

9. "A central, cyst-like filling defect in the duodenal cap" (2 cases). One of these proved to be a hemangioma 7 by 5 cm. attached to the pylorus and prolapsed into the first portion of the duodenum, the second was a myoma which also prolapsed from the stomach into the duodenum. In the latter case the roentgenologist suggested the probability of a papillomatous or pedunculated tumor.

10. "Polyposis" (2 cases). In both cases the characteristic mottled, extensive filling defects were noted, and both diagnoses were confirmed at operation.

11. "Duodenal ulcer" (3 cases). In 2 of these a duodenal ulcer was found by the surgeon, but a benign tumor was also present. In the first case a deformity of the greater curvature was noted but this was interpreted as being due to spasm secondary to the duodenal ulcer. At operation a hemangioma on the posterior wall of the stomach was found at this point, which no doubt had caused the deformity of the curvature; a duodenal ulcer was also present. In the second case, besides the duodenal ulcer, the surgeon discovered a small pedunculated fibroma in the pyloric end of the stomach. In the third case, no ulcer, but a hemangioma arising from the pyloric ring, was discovered.

12. "A filling defect on the posterior wall of the stomach, circumscribed and punched-out in appearance" (4 cases). In these 4 cases the roentgenologist suggested to the clinician that the lesion might be benign. The first case proved to be a hemangioma in the pyloric end of the stomach near the greater curvature; the second was a fibromyoma on the posterior wall in the middle portion of the stomach, the third was a fibromyoma on the posterior wall in the cardiac end, and the fourth was a myoma on the anterior wall in the middle portion of the stomach.

13. A negative report was made by the roentgenologist in 2 cases. At operation one growth proved to be a polypus; about 1.5 cm. on the posterior wall of the stomach 5 cm. above the pylorus; the other was a small adenomyoma, also on the posterior wall near the pylorus.

From a review of the roentgenologic findings in these 23 cases it seems that benign gastric tumors manifest certain signs roentgenologically, which differ from those found in malignant or inflammatory lesions. If these signs are not characteristic, they are at least suggestive:

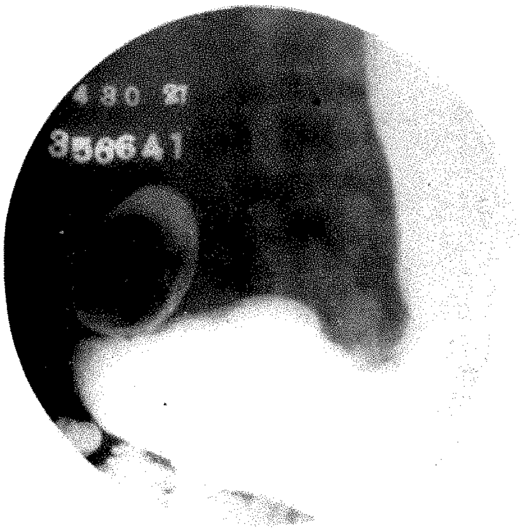

Fig. 3 (Case A356641). Hemangioma arising from the pyloric end of the stomach, prolapsing into duodenal bulb.

1. They produce a filling defect that is circumscribed and punched-out in appearance.

2. The filling defect is usually on the gastric walls, leaving the curvature regular and pliant.

3. While the rugae are obliterated in the immediate area of the tumor, just as in inflammatory and malignant lesions, the rugae surrounding a benign tumor are more nearly normal in their arrangement and distribution.

4. They cause little or no disturbance in peristalsis, and retention is uncommon except when the lesion is at, or very near, the pylorus.

5. They do not reveal a niche, nor is there any incisura or other evidence of spasm.

6. They are rarely sufficiently large to be palpated.

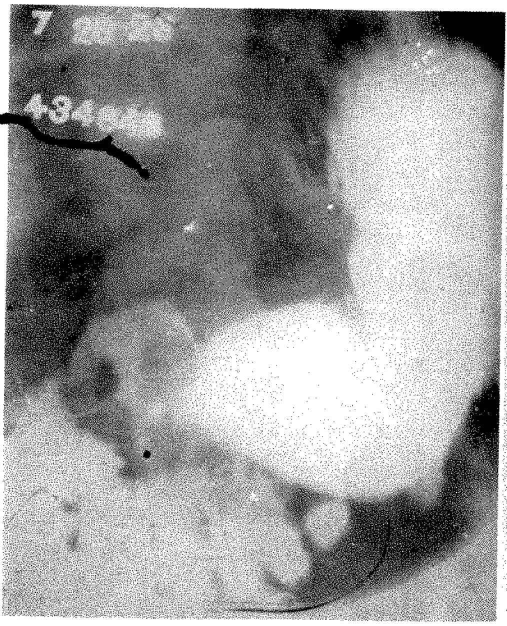

Fig. 4 (Case A434648). Myoma of the pyloric end of the stomach prolapsing into the duodenum.

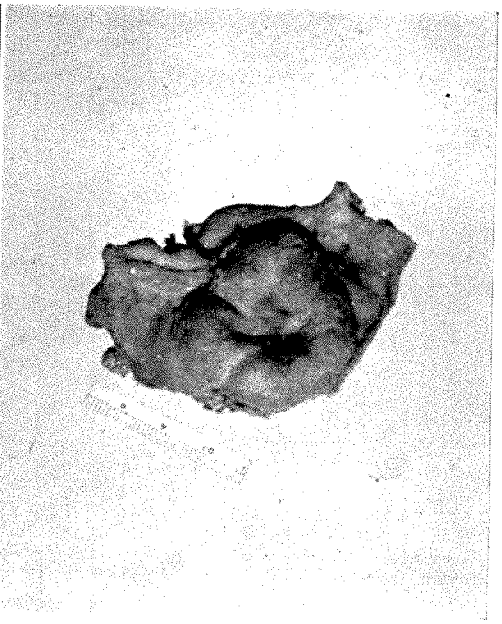

Fig. 5. Gross specimen of case shown in Figure 4.

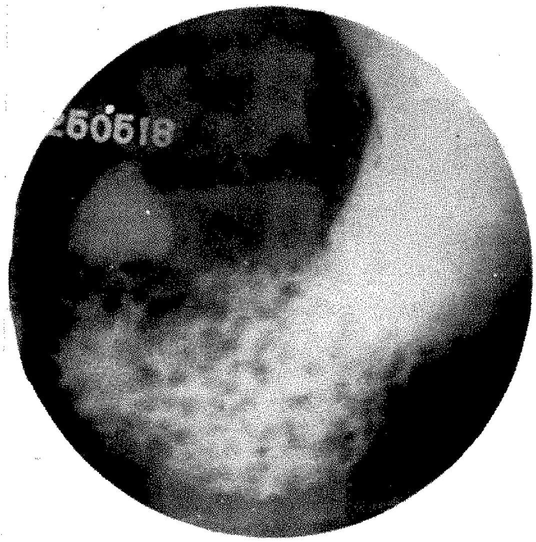

Fig. 6 (Case A250518). Extensive gastric polyposis.

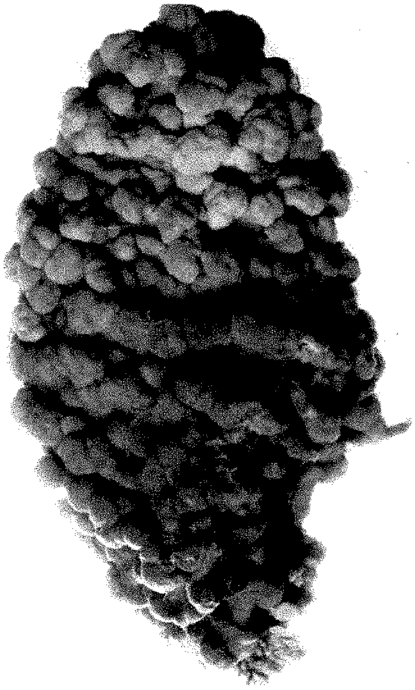

Fig. 7. Gross specimen of case shown in Figure 6.

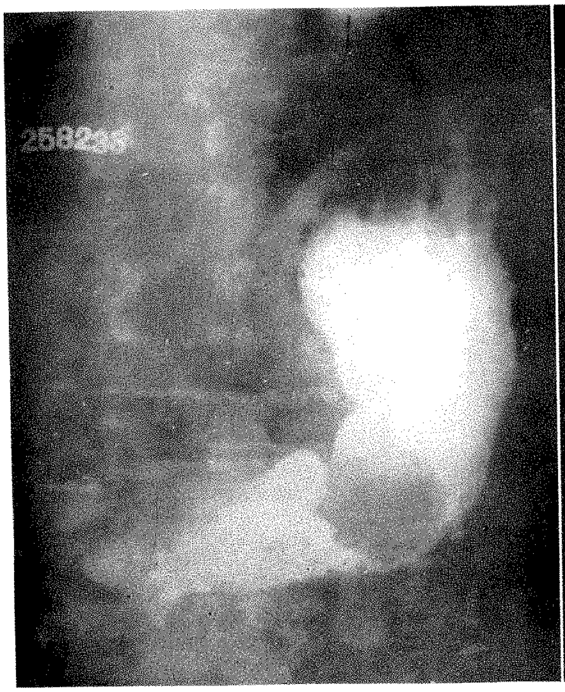

FIG. 8 (Case A258233). Hemangioma of body of the stomach.

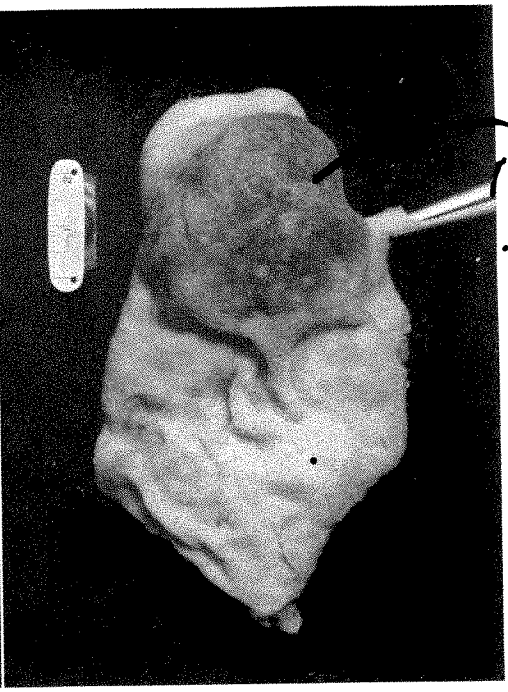

FIG. 9. Gross specimen of case shown in Figure 8.

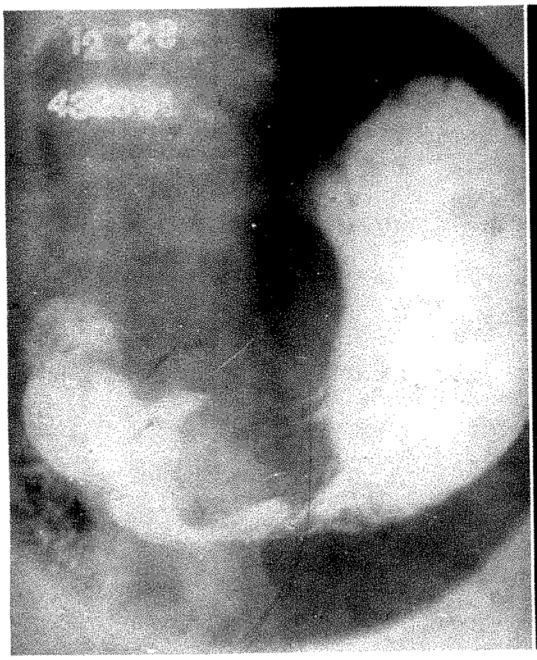

FIG. 10 (Case A432691). Myoma of the stomach with superficial ulceration.

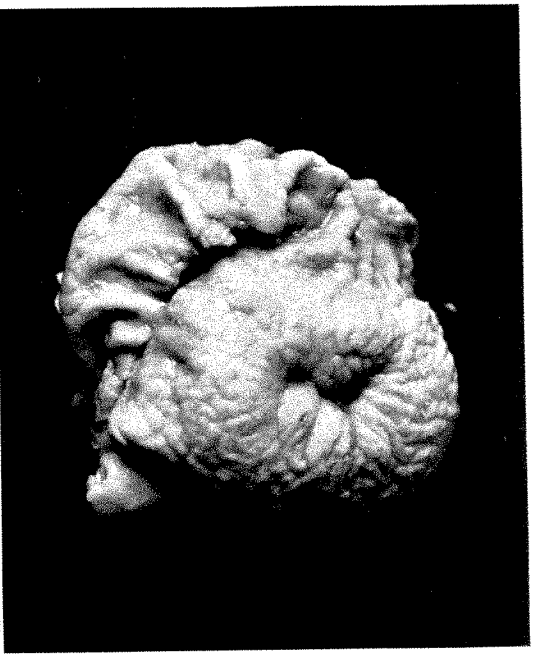

FIG. 11. Gross specimen of case shown in Figure 10.

Probably the most essential feature in the examination is the close and complete approximation of the walls of the barium-filled stomach. This can be accomplished only by deep and thorough palpation and manipulation; thorough relaxation of the abdominal muscles is, of course, necessary. The patient should be rotated in both lateral directions, and the stomach carefully scrutinized in the horizontal and vertical positions. The solution of barium should be closely observed as it enters the cardia and passes over the posterior wall, for occasionally a tumor projecting from the posterior wall will cause a splitting of the column, thereby giving the first indication of its presence. A very small benign tumor is difficult and sometimes impossible to visualize; however, even a very small tumor near the pylorus will usually produce a definite filling defect.

Differentiation roentgenologically, of benign tumors and other gastric lesions can seldom be absolute, but in many instances the roentgenologic signs warrant an attempt at such a distinction.

Medullary carcinoma of the stomach produces a filling defect usually irregular in contour and more diffuse in its involvement; it is most commonly found on the curvatures, and when on the walls, the curvatures are prone to be involved. A palpable mass corresponding to the filling defect is usually noted, and there is a marked disturbance in both peristalsis and motility.

The crater of an ulcerated cancer holds a layer of the opaque medium, producing the denser meniscus shadow, as described by Carman. The protrusion of a benign tumor produces an area, unfilled by the medium, with a shadow much less dense than that of the surrounding zone.

Scirrhous carcinoma and syphilis produce a regular, diffuse, filling defect in the stomach with a narrowed lumen and an absence of peristalsis.

A ring carcinoma, a saddle ulcer with a demonstrable crater, or a localized syphilitic lesion, when situated near the pylorus, produces a roentgenologic picture similar to that of a benign gastric tumor. However, it seems that the deformity caused by a benign tumor is less extensive and that there is much less distortion of the greater curvature than is common in the other lesions mentioned. A small gastric tumor situated near the pylorus and prolapsing into the duodenum produces a deformity of the cap which resembles that caused by a duodenal ulcer. But in such instances the deformity is more regular and central than the spastic irregularity caused by an ulcer.

The mottled appearance of gastric polyposis is so typical that the diagnosis is fairly easy, but it must be borne in mind that this picture may be simulated by the presence of multiple particles of food in a stomach filled with secretion.

From this series of 23 cases it would appear that there are no roentgenologic signs that are pathognomonic of benign gastric tumors. Nevertheless, certain findings are strongly suggestive of their presence, and when such signs are noted, the roentgenologist should hesitate to report the lesion as malignant and inoperable, especially if the clinical manifestations are indefinite.

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There is one unerring mark by which a man may know whether he is a lover of truth in earnest, viz., the not entertaining any proposition with greater assurance than the proofs it is built on will warrant. John Locke.

ORGANIC HOUR-GLASS STOMACH WITH SOME REFERENCE TO ITS SURGICAL TREATMENT*

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HOUR-GLASS stomach is commonly designated as that condition in which the stomach shows one or more constrictions at any point, or points, between the cardia and pylorus. In this paper we shall confine ourselves practically to those types producing intrinsic organic changes with only a passing mention of the spasmodic types. These constrictions, in the cases seen by us, have been more common in the middle and lower thirds of the stomach, which might be anticipated from the greater frequency of peptic ulcers occurring in these localities.

ETIOLOGY

Most of the older writers on this subject have classified organic hour-glass stomach as congenital or acquired. The weight of opinion at the present time, however, tends to exclude the former as a practical etiological factor. Moynihan[1] says, "An examination of several specimens and an earnest search through the literature of this subject has convinced me that there is no proof whatever of the existence of an hour-glass stomach due to a congenital deformity. In all the recorded examples of hour-glass stomach, where a full examination of the viscus has been made, ulceration has been found."

The type of cases we are considering are caused chiefly by some intrinsic ulcerative process with a resultant permanent change. The types of ulceration are largely the following:

1. Gastric or peptic ulcer.
2. Gastric carcinoma.
3. Gastric syphilis.
4. Tuberculous ulcers.

The condition may also be seen following the ingestion of certain corrosive chemicals with cicatrization following. The contraction following certain operations is also probably a more fruitful cause than has been supposed. Perigastric adhesions are also mentioned in the literature with considerable frequency as one of the causes.

Gastric ulcer, according to Moynihan[1] may cause hour-glass stomach in one of two ways:

1. The ulcer gradually deepens and as it approaches the serous coat of the stomach a few adhesions form binding the stomach to the abdominal wall anteriorly, or to the pancreas or liver. With the stomach thus anchored in its middle, the pouches, especially on the cardiac side, tend to sag, and this, together with the cicatricial change in the ulcer, results in the hour-glass form of the stomach.
2. Here the chronic ulcer in its healing has caused much contraction and induration and at the point of ulceration becomes markedly puckered and its lumen narrowed.

Gastric syphilis is likely to cause an area of stenosis extending over a rather wide area, the so called dumb-bell shaped deformity, in contradistinction to the relatively narrow constriction due to cicatrization, following peptic ulcer.

SYMPTOMS AND SIGNS

There are no definitely characteristic symptoms. The symptoms would depend somewhat on the location of the point of constriction, and the degree of patency of this. Those situated high in the cardia with a small upper sac may display signs of cardiospasm. In most cases these are symptoms of peptic ulcer with vomiting after meals. Usually there is considerable loss of weight and many patients are emaciated from the continued vomiting.

Osler[2] quoting from Moynihan gives the following signs as found clinically in this condition: "(1) In washing out the stomach part of the fluid is lost. (2) If the stomach is washed clean a sudden reappearance of stomach contents may take place. (3) 'Paradoxical dilatation;' when the stomach has apparently been emptied,

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

a splashing sound may be elicited by palpation of the pyloric segment. (4) After distending the stomach, a change in the position of the distention tumor may be seen in some cases. (5) Gushing, bubbling, or sizzling sounds are heard on dilatation with carbon dioxide at a point distinct from the pylorus. (6) In some cases when both parts are dilated, two tumors with a notch or sulcus between are apparent to sight or touch. To these may now be added (7) a most characteristic *x*-ray picture."

Notwithstanding the many clinical signs that have been described from time to time it is a noteworthy fact that practically no cases are referred to the roentgenologist for examination in which this diagnosis has been correctly made beforehand, and there are relatively few recorded cases in the literature in which the diagnosis has been made clinically before operation.

ROENTGEN RAY EXAMINATION

It is evident that even if the diagnosis is made without the aid of the roentgen ray no idea is gained as to the size of the pouches, the position of the constriction, or the possible origin of the condition, so that very little aid in determining the type of treatment is obtained.

The roentgen examination should be made in the usual manner by means of the roentgenoscope in the upright and prone positions, followed by roentgenograms in either or both of these positions.

The picture of biloculation or hour-glass stomach may be shown by a number of conditions. Chief among these are, in the order of frequency: (1) Reflex (spasmodic), from lesions outside the stomach; (2) spasmodic, from intrinsic lesions as ulcer or carcinoma, and (3) organic hour-glass.

In cases of the reflex spasmodic type the exact etiology is often a most difficult matter to decide. The three most common causes are probably: (1) Chronic appendicitis; (2) chronic cholecystitis; (3) duodenal ulcer. The first two types can usually be relaxed by the administration of belladonna until the full physiological effect, dryness of the mouth and dilatation of the pupils, is obtained The third type will in most cases be unaffected by belladonna, so that in all cases duodenal ulcer must be definitely excluded. Case, quoted by Barclay,[3] described this condition in 1913 noting it in sixteen cases of duodenal ulcer.

The intrinsic spasmodic type is often seen in connection with gastric ulcer and cancer. The contraction is usually opposite the ulcer and may vary from a slight indentation to a large, usually V-shaped defect. This is most difficult to differentiate from the true organic type, as antispasmodics have no effect upon it. Repeated examinations, especially after medical management, will often reveal its true nature.

Gastric carcinoma shows this spastic effect with considerably less frequency than ulcer and when seen, the typical filling defect due to the growth will usually make the origin clear. According to Carman,[4] this is manifested by an indrawing of the greater curvature opposite the growth and the contraction is much wider than the contraction due to ulcer which may be a very narrow slit.

The true organic hour-glass stomach resulting from the effects of the cicatrization following gastric ulcer will usually give the stomach the shape of the letter B; the lesser curvature forming the vertical line and the greater curvature being indrawn. In most cases the constricted area is rather short and with the sagging of the upper loculus it may be necessary to elevate this by palpation to see the constriction in its entirety. There is frequently a six-hour retention, although usually in this examination the upper loculus is found to be empty. In some cases the stomach is found to be fixed by adhesions. Many cases present a niche or accessory pocket on the lesser curvature at the point of narrowing, suggesting the origin of the constriction.

Undoubtedly a part of the constriction in many of these cases is spasmodic, and we have been struck by the relatively larger opening found at operation than was suspected from the roentgenogram. However, we have found practically no change in the opening following the physiological effect of belladonna.

In carcinomatous hour-glass, the findings are usually those of gastric carcinoma in which the involvement is of such a type that a biloculation of the stomach has been formed. There is often irregularity of the outline, and a tumor can be felt confirming the suggestion of a new growth. The whole lumen of the stomach may be contracted down for a considerable distance giving the so-called dumb-bell stomach described in gastric syphilis by LeWald.[5]

In syphilitic hour-glass stomach we have observed few findings which roentgenologically will differentiate it from gastric carcinoma, and we believe that this diagnosis is usually made because of certain clinical findings which suggest a condition of a more chronic and less debilitating form than gastric cancer.

TREATMENT

The treatment in most cases of this type is surgical, if a permanent result is to be obtained. In following the course of these cases it has become apparent that the roentgenologist may be of considerable assistance to the surgeon in deciding upon the type of operation to be undertaken in any given case. If one considers the portion of the stomach constricted, the emptying power of the resultant pouches and the clinical condition of the patient, the best type of operative procedure can be foretold with considerable accuracy.

Moynihan[1] lays stress upon the fact that in the surgical treatment the pyloric opening must be taken into account as well as the point of narrowing, as the former may also be obstructed by a second point of ulceration. This point can be preoperatively determined by the roentgen-ray examination and a decision reached as to the advisability of arranging for drainage of the lower as well as the upper pouch.

Watson[6] favors gastrogastrostomy as the operation of choice if the circumstances are at all favorable for its performance. The advantage of this is that it allows a large communicating opening to be made between the pouches, thus avoiding the area of cicatrization with its thickened inelastic walls. He advises against resection of the constriction as being a much more dangerous type of operation, except in the simpler cases.

In a group of 37 cases Eustermann[7] reports 10 cases treated by gastrogastrostomy; posterior gastroenterostomy, 8; resection, 2; Hartman gastroplasty, 5; and the remainder by various single and combined operations.

In considering these cases one could begin by dividing them into three classes: (1) Those in which the point of narrowing is in the lower third; (2) those in the middle third; (3) those in the upper third.

Taking up the first class it will be apparent that in most of these the lower sac will be so small and the walls so much indurated that as a digestive factor it is of little consequence. Our greatest problem here, then, is to afford adequate drainage of the upper large pouch, which, barring other complications, can usually be best attained by a posterior gastroenterostomy. The small amount of stomach contents which goes through the point of narrowing will usually pass through the pylorus and will afford no further trouble.

In the second class we have two pouches of approximately the same size. Our problem here is to unite the two pouches, thus preserving the normal digestive function. This can be done by a gastrogastrostomy, making a large connection between the pouches, or by a resection of the constricted area. The former is much the simpler and is usually recommended because of its lower mortality, especially as many of these cases, because of long-continued vomiting, are emaciated and are poor surgical risks for any extensive operation. Resection may be undertaken if the constriction is short and there is no evidence of adhesions binding the stomach tightly to surrounding structures, and the patient is in fairly good physical condition. If retention is found in the lower sac, caused by obstruction at the pylorus, then some operation such as pyloroplasty or gastroenterostomy must be performed to relieve this. Some have also advocated gastroenterostomy openings in both pouches to relieve this condition.

In the third class, showing constriction in the upper third, it is desirable, if possible, to afford drainage to the lower pouch. This can be done by a gastrogastrostomy or some type of plastic operation. None of our operative cases has been in the third class.

No attempt has been made to designate all types of surgical measures which might be undertaken in cases coming under the foregoing classification, but rather we have attempted to indicate a few of the more generally used operations which are applicable in these cases.

Medical treatment in this condition is chiefly indicated as a temporary measure to improve the patient's general condition so that the appropriate surgical measures can be carried out. No permanent medical results could be expected in any case where the changes are due to fibrotic contraction. This treatment should be limited to those cases of spasmodic hour-glass due to some intrinsic lesion or to syphilitic hour-glass in order to remove all evidence of infection. Then if the hour-glass condition persists it can be safely assumed, that it is fibrotic in nature, and can be treated accordingly.

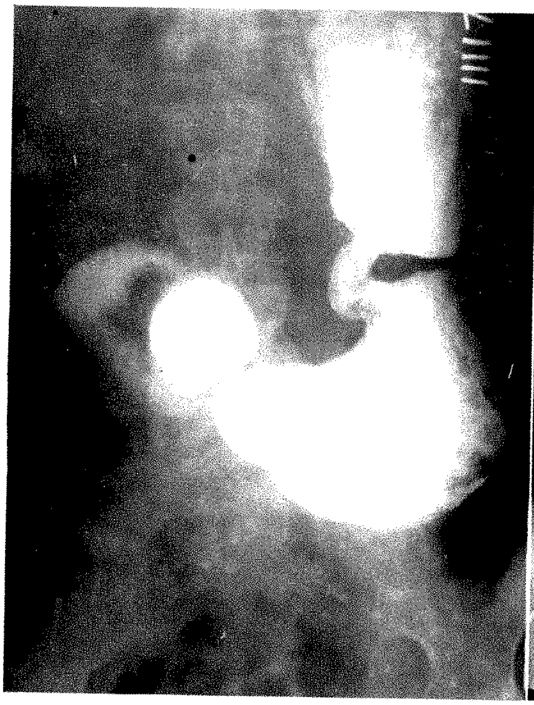

Fig. 1. Hour-glass stomach with canal along lesser curvature. Old ulcer pocket present at point of constriction. Before operation.

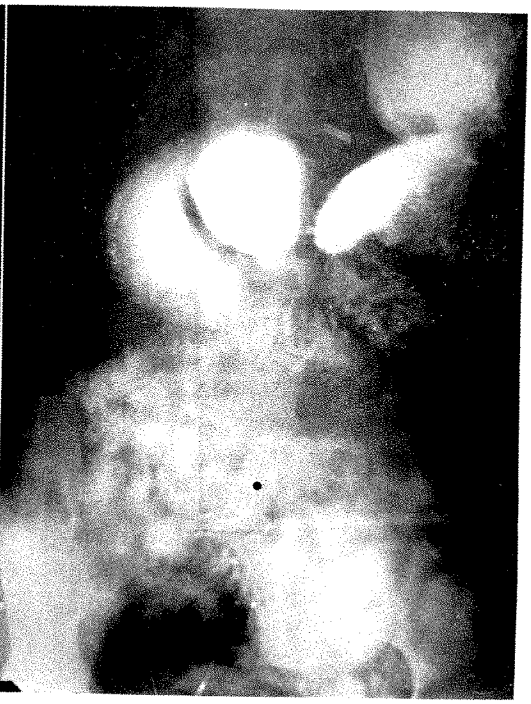

Fig. 2. Same case as in Figure 1. After gastrogastrostomy operation, showing deformity. There was no retention in five hours.

CASE HISTORIES

Case I. Female.

Complaint. Vomiting and gas on the stomach.

History. The patient gives a rather definite history of chronic ulcer with considerable vomiting during the last several years.

Roentgen Examination. A very definite hour-glass constriction was seen in the middle portion of the stomach with the channel on the lesser curvature (Fig. 1). The two pouches were approximately equal in size. There appeared to be the remains of the crater of an old ulcer on the lesser curvature at the point of constriction There was about 25 per cent retention in the lower pouch at the five-hour examination. There were also some adhesions in the upper right quadrant.

Operative Notes. Adhesions of omentum to gall-bladder and spleen. Indurated mass in the central portion of the stomach with some dilatation of the two gastric pouches. The pyloric opening was free. The other viscera were negative. A gastrogastrostomy was performed.

The second roentgen examination one month following operation showed a somewhat angulated stomach without any constriction (Fig. 2). There was considerable hypermotility and no retention in five hours.

This operation was performed four years ago and since that time the patient has been in excellent health with no recurrence of the previous trouble.

Case II. Female, aged fifty-two.

Present Illness. Stomach trouble for the last twenty years consisting of pains in the upper left quadrant with vomiting after meals. Vomitus sometimes contains blood; occasionally there is melena.

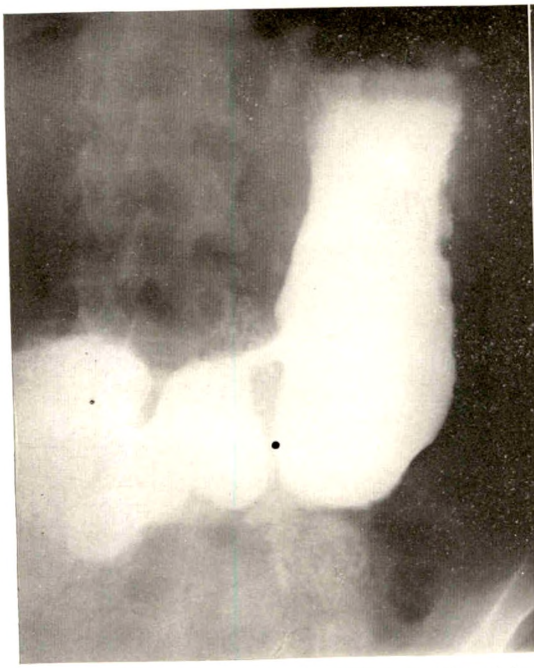

Fig. 3. Hour-glass stomach involving pars media, with canal along lesser curvature. Before operation.

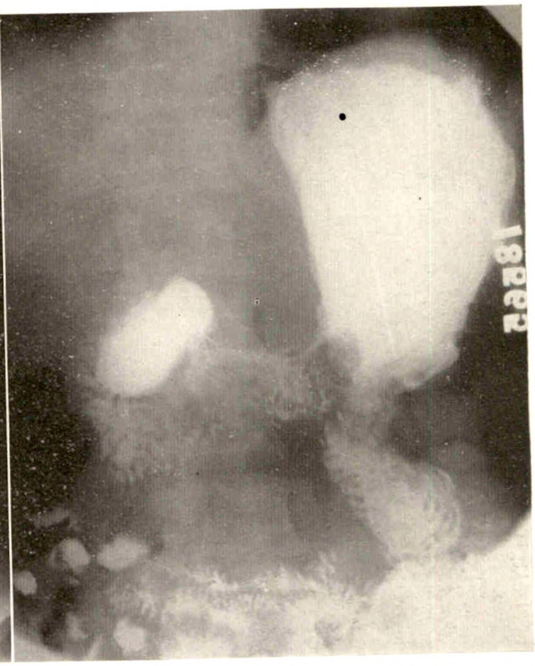

Fig. 4. Same case as in Figure 3. After gastroenterostomy operation. Good emptying power.

Roentgen Examination. A definite constriction in the pars media of the stomach with the opening along the lesser curvature (Fig. 3). The pouches were approximately equal in size.

Operative Findings. Hour-glass stomach with ulcer of the stomach and adhesions around the gall-bladder. A posterior gastroenterostomy was performed, the posterior aspect of the upper pouch being approximated to the upper jejunum.

The second roentgen examination one month after operation (Fig. 4) shows that a posterior gastroenterostomy has been done in the most dependent portion of the upper pouch of the stomach; this is functioning very well. A small amount of barium also passed through the pylorus. The stomach was practically empty in five hours.

The patient has made an uneventful recovery and one year following operation is in excellent condition with no evidence of the previous trouble.

Case III. Female, aged fifty.

Complaint. Distress in the abdomen, nausea and vomiting.

Past History. Has had this complaint for fourteen years with two severe hemorrhages at the beginning of that time, and was under hospital care for one month.

Roentgen Examination. A definite constriction at the junction of the pars media and antrum (Fig. 5). The opening appeared to be along the lesser curvature of the stomach and several inches in length. The duodenal cap was negative. There was about 60 per cent retention in five hours, both pockets being well filled (Fig. 6).

Operative Findings. Appendix normal; gall-bladder buried in adhesions; hour-glass contraction of the stomach in the middle third which consisted of dense fibrous tissue. A gastrogastrostomy was performed uniting the two pouches of the stomach.

The patient made an uneventful recovery and one and one half years after was in good health with no return of the previous symptoms.

Case IV. Female, aged thirty-eight.

Complaint. Pain in stomach shooting up into the chest.

Present Illness. Sharp pain in stomach coming on one-half hour after eating, relieved by drinking milk. Usually vomits one-half hour after eating. Vomitus contains no blood.

Roentgen Examination. There is a definite hour-glass constriction in the pars media with the channel along the lesser curvature (Fig. 7). There is also a small crater formation extending out from the lesser curvature at the point of constriction. This appears to be an ulcer crater. The stomach was entirely empty at the five-hour examination.

Operative Findings. Hour-glass contraction in the pars media due to chronic indurated ulcer on the lesser curvature. A sleeve resection was done removing a circular cuff 2 in. wide. This gave the stomach a lumen admitting four fingers at this point.

The second roentgen examination one month following operation showed a constant point of narrowing in the pars media although there was a rather large lumen through this, producing no definite obstruction. The edges of this were smooth. The duodenal cap was negative. There was about 30 per cent retention in the stomach in five hours.

The third roentgen examination two months following operation (Fig. 8) showed the same point of narrowing in the pars media which was approximately the same size as at the previous examination. There was 50 per cent retention in five hours.

The fourth roentgen examination five months following operation showed the point of narrowing in the pars media to be somewhat narrower. The patient had been growing worse gradually and was in a weakened condition.

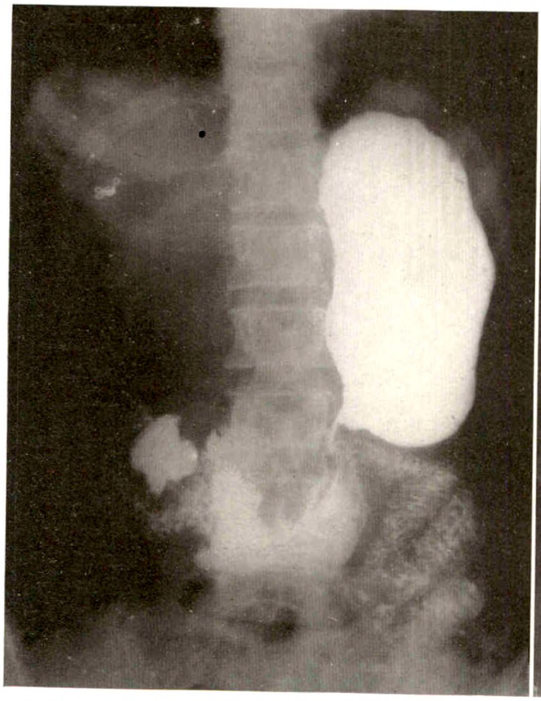

Fig. 5. Hour-glass stomach with canal along lesser curvature.

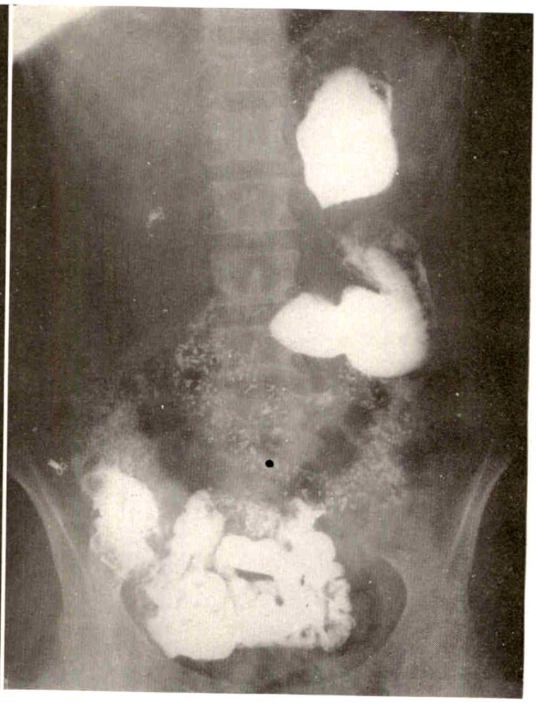

Fig. 6. Hour-glass stomach showing amount of retention in five hours. Same case as in Figure 5.

A second operation was undertaken and a gastroenterostomy to the upper sac performed but the patient died within two days.

Case V. Male, aged forty-one.

Present Illness. Has had stomach trouble for twenty years. Complains of gas, nausea and distress following meals, which is relieved by vomiting. Has been gradually growing worse.

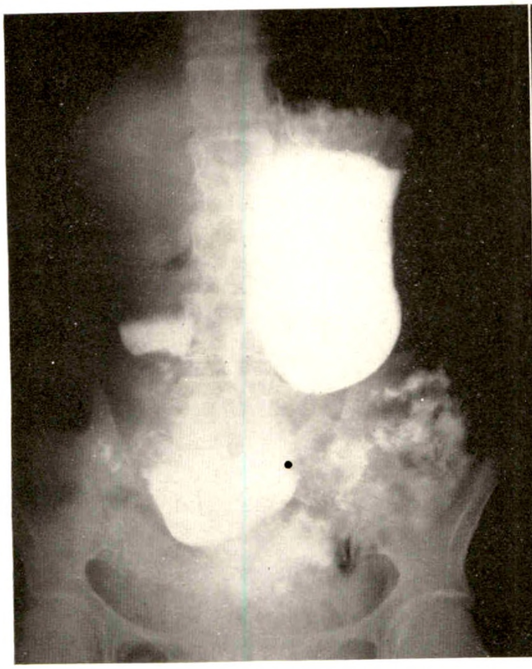

Fig. 7. Hour-glass stomach showing small ulcer crater on lesser curvature at point of constriction. Before operation.

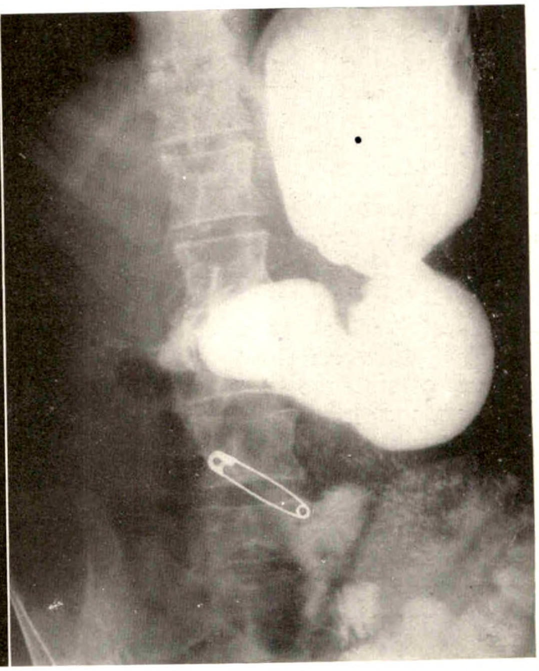

Fig. 8. Same case as in Figure 7, following sleeve-resection of constricted area. Constriction of moderate degree persists.

Roentgen Examination. There is a large, deep crater-like ulcer located in the middle third of the lesser curvature. There is a rather deep constriction located opposite the ulcer involving the greater curvature with the channel along the lesser curvature. The stomach was completely emptied in six hours.

Operative Findings. Large crater ulcer in the middle portion of the stomach with a large amount of induration and contraction around this region. The pylorus and antrum were negative. A resection of this entire region was done and the cut ends of the stomach united. The patient had a rather stormy postoperative course and died about three weeks later.

CONCLUSIONS

1. Organic hour-glass stomach is usually caused by some intrinsic ulceration with resultant fibrotic contractures.

2. Clinical signs and symptoms are somewhat indefinite.

3. The roentgen picture is definitely characteristic and will often demonstrate the etiology.

4. The treatment is essentially surgical, and the best type of operative intervention can frequently be foretold from the roentgen picture.

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DEFECTS IN THE CONTOUR OF THE STOMACH SIMULATING HAUDEK'S NICHE*

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IN 1909 Reiche[1] showed the outline of a defect on the lesser curvature of the stomach in a case which came to autopsy, and a deep penetrating ulcer was found at the site. Haudek[2] was the first to describe in detail this defect or projection of the bismuth shadow as a sign of penetrating or callous gastric ulcer. More data on it was presented by him in the Archives of the Roentgen Ray in 1911.[19] In this article he states that up to the time of its publication he had observed 38 cases of gastric ulcer showing this symptom. In all but one of these cases the lesion was situated on the lesser curvature. The characteristics of the niche as observed by him were described as follows:

1. A diverticular projection from the stomach shadow on the lesser curvature.
2. The persistence of this diverticular shadow under palpation.
3. The presence of bismuth residue in the diverticulum.
4. The presence of a hemispherical gas bubble above the bismuth shadow.

Carman,[3] on the basis of his extensive experience at the Mayo Clinic, defines the niche as "the visualized crater of a penetrating ulcer, the cavity of which lies entirely in the wall of the stomach." He states further: "Its size may vary from a mere fleck to a considerable protuberance" and "it is worthy of note that a niche may be demonstrable even though the ulcer has not penetrated very deeply." He adds: "A small niche in any situation may be hidden or partially obliterated when the stomach is distended, so that careful observation should be made while the stomach is filling, especially while the patient is drinking the mixture." In conclusion he states: "The bulge between two peristaltic waves close together on the lesser curvature often looks very much like a niche, and conversely a true niche may be mistaken for this bulge. However, as the waves progress, the bulge moves toward the pylorus while a niche remains stationary, a screen study being necessary to make the distinction."

In 1920 Carman[4] reported that of 3,890 gastrointestinal cases examined roentgenologically at the Mayo Clinic in 1918 to 1919, 111 were diagnosed as gastric ulcer. Of these 88 were operated upon and the diagnosis confirmed at operation in 84 (95.45 per cent), but he does not state what percentage of these cases showed the typical niche symptom. Béclère[5] reported 10 cases which showed the niche and he considered the sign "absolutely pathognomonic of gastric ulcer" but states that he had observed it only in ulcers of long-standing, and Carnot, Harvier and Mathiew believe likewise. Cole[6] regards Haudek's niche as most important in the diagnosis of gastric ulcer and believes symptoms to be of practically no value in comparison with this direct evidence of the lesion, but in this connection he mentions the presence of the "bubble of gas," and with this qualification he is no doubt perfectly accurate. Diamond's[7] article strongly suggests that he considers the niche pathognomonic. Faulhaber[8] in 1910 agrees with Haudek's report and confirms his observation that it could not be made to disappear by palpation. Schlesinger[9] in his recent book agrees with Cole in that when a defined niche is present the diagnosis of gastric ulcer can be made without reference to the clinical history. Schulze,[10] during the war years in his country, employed the presence of the niche to prove an increasing incidence of callous gastric ulcer.

Other articles, all in agreement with what has been stated, have been presented by Åkerlund,[11] Carman,[12, 13, 14, 15] Carnot,[16] Haudek,[17, 18, 29, 20] Held and Gross,[21] Hess,[22] Holding,[23] Kupferle,[24] Levy,[25] Magee,[26] Reiche,[1] Schuller,[27] Scargill,[28] Secher,[29] Simon[30] and Singer.[31]

The very latest literature on the subject contains an article by J. Buscher[32] reporting observation of 700 cases of deep-seated ulcers roentgenologically visible. In these he reports that hour-glass contraction and the niche, either persistent or temporary, are the most important signs. He, however, makes diagnostic distinction between true and spastic hour-glass contraction. The greatest interest is attached to the niche, especially since Haudek and Faulhaber had called attention to it, and he definitely states that the existence of a niche may be assumed to warrant the diagnosis of gastric ulcer. His description of a niche is: "A diverticular spot of barium extending from the main shadow, which pressure cannot dislodge and which represents a callous or penetrating ulcer." He draws attention to the various shapes and sizes of niches, describing them as diverticular sacculations, and those on the lesser curvature as of sugar-loaf, pedunculated and mushroom form, varying in size from a lentil to a hazelnut or walnut. The only possibility of error to him is when adhesions form a pouch by traction on the walls of the stomach, resulting in deceptive findings.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18-21, 1923.

On the other hand Kurtzahn,[33] on the basis of 100 observations in gastric ulcer, states that the niche, continuous spasm, rolling in of the lesser curvature and circumscribed pressure points are the important factors, with the typical niche present in about 25 per cent of ulcer cases. After drawing attention to the possibility of niches on the anterior and posterior walls, he states that in some cases, despite a pronounced niche, doubt as to the diagnosis of ulcer is justified. In this he suggests error he had made in being too definite, and very generally in the roentgenographic diagnosis of gastric ulcer his observations coincide with my own experiences.

As is well known to this audience, what is popularly designated as Haudek's niche is a departure from the normal continuous outline of the stomach shadow which is permanent in a considerable series of observations and which is not displaced or obliterated by palpation. You also know that such a characteristic departure may be temporary or transient, and when this is the case, it is not of significance. It is not our fault that gastric ulcer is too often diagnosed on a limited or incomplete observation, and that too often the phantom form is used to diagnosticate gastric ulcer when it is not present. But this leads us to a matter of more significance. May the phantom form, which is only a phenomenon of peristalsis, be permanent throughout the average length of time we use in the examination of the stomach, which is usually terminated in a six-hour session in the one person and the taking of about a dozen films? I am strongly inclined to the belief that this is so in some instances. There have been not a few cases, the films of which I have seen, with apparently a definite Haudek's niche throughout all of them, that were operated upon and on careful search no lesion was found. It is for this reason that I take leave to offer this for your consideration, so that you may devise some measures for the elimination of the error. Another point worthy of thought: In the last two years I have seen 9 instances of ulcer diagnosis in which more than two roentgen examinations were made (the shortest, one week intervening, the longest seven months, in which four examinations were made), and a Haudek's niche was constantly present in all and yet there was no ulcer. Logically, we may ask ourselves the question: "Is there not a peristaltic phenomenon in some stomachs which is normal in these

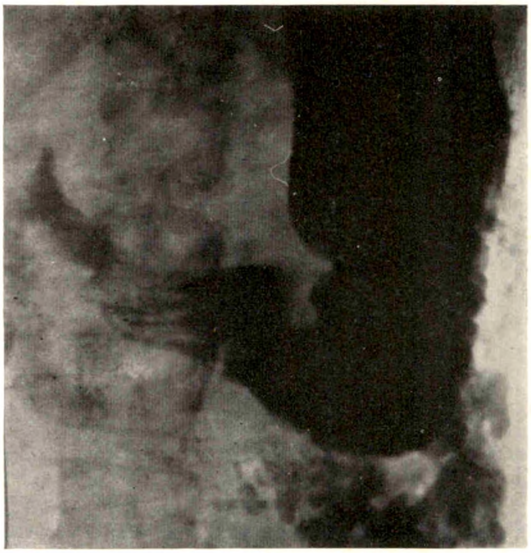

FIG. 1. Diagnosed as ulcer on roentgen-ray findings. No symptoms of ulcer. Stomach showed no lesion at operation (hysterectomy). Result satisfactory.

persons, and yet which is a Haudek's niche roentgenologically?" I feel quite sure that this must be so, and in a practice which like yours, is made up largely of referred work for diagnosis one cannot afford to have other than full cognizance of any very practical matter such as that which pertains to the accurate diagnosis of gastric ulcer.

Further, since much consideration of this subject is now found in medical literature, if there is any doubt about what some of us have granted as pathognomonically diagnostic of gastric ulcer, even when clinical symptoms of ulcer are not present, then surely roentgenographic or roentgenoscopic observations showing its disappearance under medical treatment brings about some question of the accuracy of many of the favorable deductions that today are being broadcasted as proof conclusive of cure. In this you may refer to the literature of Caille and Montier,[34] Diamond,[35] Ohnell,[36] Einhorn,[37] Hamburger,[38] and Hollander.[39] May I add in this connection that I have had 27 instances of definite niche, three with gas bubble, which disappeared under medical treatment and on return of symptoms all of them were operated upon and large calloused ulcers observed. In addition to this, there have been a significant number of cases in which niches were present but which, in my belief, were not gastric ulcers, the defect on the lesser curvature disappearing upon treatment in which rest had a part. There have been at least fifty of these in the past two years, some being treated medically, others surgically. It would be very difficult for me to believe that any of them were instances of gastric ulcer.

Haudek's niche was and is seemingly accepted without question by roentgenologists, gastroenterologists and clinicians the world over as pathognomonic of gastric ulcer. It apparently was sufficient that Haudek drew attention to it for its accuracy to be taken for granted by others. This acknowledgment of Haudek was as complete and complimentary as was, and is, the merit of that worker in roentgenology. No real lover of the profession of medicine like myself would utter a word of opposition to such, for one of the sad things of the learned professions is that scientific advance is too often met by unfair criticism and unnecessary modification, or acknowledged by selfish plagiarism. Haudek was the first to draw full attention to a very valuable means of diagnosing

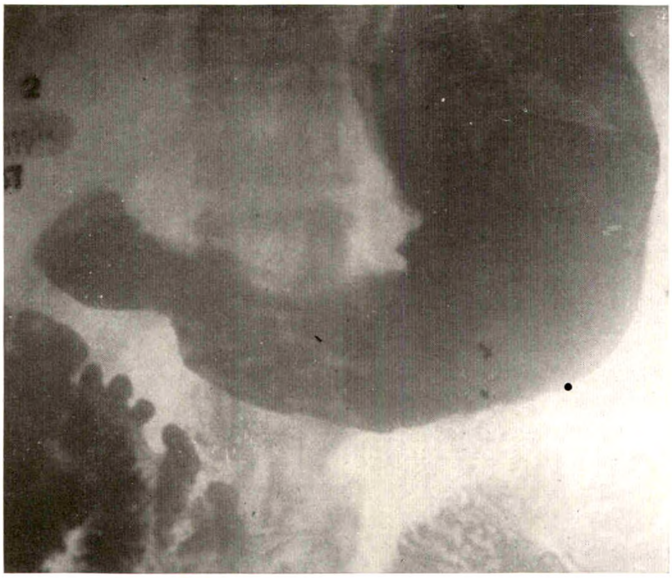
FIG. 2. Diagnosed as gastric ulcer on roentgen-ray findings. No symptoms of ulcer. Treatment, cholecystectomy. No stomach lesion present. Result good.

gastric ulcer, and his work in this regard was most signal and should be respected as such by all. Personally, we acknowledge to him and to the others a debt of gratitude, and we hope not to be misunderstood in this. Many have been the instances in which its presence has been of help in our work.

For a long time the presence of a permanent non-displaceable niche was sufficient indication that a gastric ulcer was positively present. After the fifth operation in which ulcer could not be found, I became more observing and watched this phenomenon with some interest. For the past two years I have not been so definite about it and in addition have required clinical symptoms of ulcer or persistent gastric trouble to be present. At a recent medical meeting,[40] during a discussion on ulcer treatment, many plates were displayed and the disappearance of the niche was used as proof conclusive of the value of a certain medical treatment. I ventured the statement that there might be error in the diagnosis or in testing the results of treatment, in which the niche alone was employed as the only or pivotal point of diagnosis and treatment. A very well known New York City gastroenterologist and others took critical issue with me, showing that they had taken this point for granted as I had formerly done. After a perusal of the literature on treated cases in which the presence of the niche made the diagnosis, and its disappearance was employed as proof of cure, I realized that a communication of caution on the subject was timely. Although my fellow clinicians were definite in their beliefs, it must be reported to the credit of our past president, Dr. William Stewart, who was present at the time, that he did not enter the discussion but quietly asked me at the close of the meeting to report my experience.

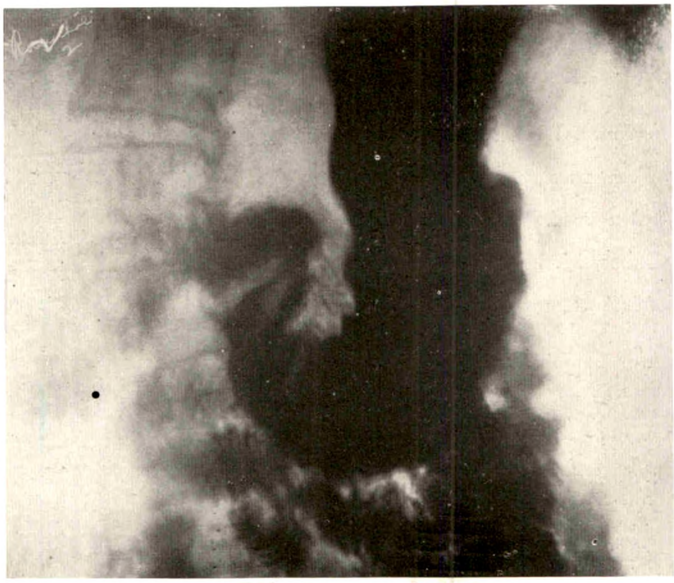

FIG. 3. Diagnosed as gastric ulcer on roentgen-ray findings. No symptoms of ulcer. Stomach found normal at operation for another condition (salpingectomy). Result good.

Since then we took each operated case that came along, and during the short intervening period between April 1, 1923 and July 1, 1923, we have collected reports and slides on 5 out of 39 cases of gastric ulcer seen.

The accompanying illustrations (Figs. 1, 2 and 3) show the folds on the lesser curvature which were erroneously interpreted as Haudek's niche.

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DISCUSSION[1]

Dr. L. G. Cole, New York. The president has asked me to open the discussion on these papers. I would like to talk on all three of the papers, but I am not going to. I am not going to say any more on the very able paper that Dr. Moore has presented. His conclusions, or the lantern slides, speak very finally for the diagnosis as he has given it.

So far as the paper on hour-glass contracture is concerned there is just one point that I would like to make. I like to make it every time I can; that is, that many of these cases of so-called spasmodic constrictions, spasmodic hour-glass constrictions, are called "spasmodic" because the surgeon doesn't find them, and they are considered not to be there. As a matter of fact, what happens is that the cicatricial contraction involves only the mucosa and the submucosa, which are drawn away from the serous coat and the mucosal and submucosal coats protrude as a narrow band into the lumen of the stomach. The surgeon looks at the outside of the stomach which is apparently normal in contour, especially when the stomach is empty, as it usually is when the patient is operated upon.

I wish to devote most of my time to a discussion of the third paper. I can't quite conceive what may be the object of that paper. One would have judged that it was proved that the roentgen examination is not accurate, that the presence of the niche is not conclusive evidence of a gastric ulcer. Well, now, I really expected that the writer would give us something of value, that he would show some of the difficulties in differentiating other defects from Haudek's niche, that he would show a jejunal diverticulum, or stones, the shadows of which protruded beyond the stomach, or sixteen other things which I have described on previous occasions and hope to get out some time, that will have to be differentiated from the niche. But there weren't any of those things at all.

Some *x*-ray man, I just like to call him an *x*-ray picture man, has interpreted those as a Haudek's niche. Well, now, I believe that the great majority of the men present here recognized the absolute absurdity of presenting to a national organization of this kind a paper like that.

I was present at the meeting where Dr. Bassler referred to this series of plates which had been demonstrated in Washington. We need not mention the man's name, but he came there with a series of plates that proved that some particular type of ulcer cure was effective. Now I had an opportunity, through the courtesy of the publisher of this Journal, to study those cases in detail prior to the meeting. I had an opportunity then to study them as they were presented, and there was only one of those cases out of that large series which this man quoted as ulcer cures in which there was roentgen evidence of an ulcer. And, therefore, I agree heartily with Dr. Bassler on that point. But I am surprised that he should have come here and shown us clear-cut peristaltic waves which caught a particular passing cycle, show something which might possibly be interpreted as a crater. Is it possible that he really believed that those were ulcers, or did he just try to indicate that the roentgenologists were inexperienced?

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[1] This discussion has reference to the preceding papers by Drs. Moore and Doub, as well as to the above.

Well, I didn't just get the gist of what he was trying to show, but I do feel that there wasn't a single one of those slides that showed an ulcer, with the possible exception of one, and of that there was a great deal of doubt. It would take serial roentgen examination of the various phases of the various cycles, and enough of them to make a diagnosis before one is justified in expressing an opinion, and in that type of case I would suggest the probability is we would have to repeat the examination in order to avoid errors.

Dr. W. H. Stewart, New York. As I feel some responsibility for the presence of Dr. Bassler here this afternoon, it might be well to tell "how it happened."

At a medical meeting last winter Dr. Bassler made the very radical statement that a Haudek niche did not always indicate ulceration. He stated he was confident of this fact but was not prepared at that time to prove his statement so I suggested that he come out to the next meeting of the American Roentgen Ray Society and tell us about it, so he is really here at my invitation; that perhaps will answer Dr. Cole's question.

Dr. Bassler has not proven his point. His paper should have been entitled "The Misinterpretation of Haudek's Niche," as all of his cases were misinterpreted. I feel very positive that if the Haudek niche is present, it *does* indicate ulceration.

Now, gentlemen, don't depend entirely upon your budding. Dr. Cole taught us many years ago that in the interpretation of an excavating ulcer, you must not only have the budding appearance, but the flattening around the protrusion as well.

Dr. Bassler's reference to the roentgen examination as indicating the amount of healing in an ulcer is extremely interesting. We have been able to show great variation in the size of the ulcer shadow within a few days; sometimes it will disappear entirely, probably due to the crater filling with food or mucoid substances, so that one may well hesitate to accept the roentgen findings alone as indicating the healing of an ulcer. If, however, the ulcer crater, as shown roentgenographically, persistently and progressively diminishes in size and this contraction is supported by a corresponding improvement in the clinical manifestations, then one can, with reasonable security, feel that the ulcer is healing.

Dr. Gray, Richmond. I was very glad indeed to hear Dr. Stewart refer to the fact that clinicians have been attempting to use roentgen-ray methods to prove the healing of ulcers.

We have seen published in the medical literature in various portions of this country demonstrations of medical healing of ulcers. I have been asked time and again to "please examine this patient, and see how this ulcer is coming on, which you discovered a year ago," or "six months ago." Invariably I tell the clinician that I can give him practically no information as to whether or not this ulcer has healed. If, perchance, it has been a superficial ulcer, especially one involving the bulb of the duodenum, and the ulcer has so healed as not to leave any cicatricial contraction or any adhesions, then we can say that in all probability the ulcer has healed. But how often do we see that? I think all of us should take the position that we cannot tell whether or not an ulcer is healing except in those very rare cases mentioned.

Dr. L. T. LeWald, New York. I would like to show a slide that will illustrate a type of deformity of the stomach due to perigastric adhesions, which I am not sure that Dr. Doub particularly mentioned, but might be mistaken for an organic lesion of the stomach. In this case there had been a previous operation, exploration on the gall-bladder, and following that the patient had gastric symptoms, and on operation there was found the very definite restricting band across the stomach, over to the gall-bladder region. Now the differential diagnosis in this case could be made, because there was a shifting of the narrowed parts of the stomach, although the latter remained about the same width. In case one gets a shifting deformity of the stomach of that sort, he might possibly diagnose perigastric adhesions as the cause of the phenomenon.

Now I think Dr. Doub left the impression, possibly, that mediogastric resection was not an advisable operation as a rule. I would like to state that in about 30 cases which we have followed after operation, where mediogastric resection has been done, there has been perfect functioning of the stomach. We have a case like one which he showed, in which there was not good functioning of the emptying of the stomach. In that case a second operation was performed, and a pyloric stenosis relieved which had been present at the time of the first operation but not recognized. I think the operation is a very good one in the hands of a surgeon who is experienced in the use of the operation and uses excellent judgment at the time of operation as to whether he can, in a short time, make a successful closure of the wound.

The next case is one of an extremely deformed type of stomach—a trifid stomach. It is about the only one in the series of hour-glass stomachs lost after operation. There was a very complicated deformity, in which the question of a gastrogastrostomy was discussed, but at operation that was not performed on account of the extensive perigastric adhesions, and a loop of intestine was brought up and placed at the upper pouch. That loop of intestine unfortunately proved at the autopsy, which occurred about a week later, to be the ileum. That might have been avoided if sufficient attention had been paid, possibly, to the roentgen-ray interpretation. In the report it was stated that a portion of the meal at the six-hour period was up in this region, indicating that ileum might be present in that region.

Dr. Moore's paper is exceedingly interesting. We had one case of food retention that very closely simulated gastric polyposis. In fact, the clinician in that case who came into the laboratory before I saw the plate made such a diagnosis, but he was very willing to reverse his findings when I insisted that he wash the stomach out, and when we repeated the procedure, the appearance of polyposis had disappeared.

The dragging into the duodenum of the large gastric polyp was interesting. It is very similar to a case of carcinoma of the ileocecal valve in the exhibit room, in which the small intestine was dragged in and made an intussusception.

Dr. Bassler's cases, I am sure, were brought out largely on account of the discussion in regard to the question of the healing of ulcers. At least that is what I expected would be the discussion, and it is curious that a case which shows a definite niche cannot always be demonstrated a short time later. I know two or three cases like that. And even his contention that peristaltic waves may simulate an ulcer crater is not so far-fetched. I have known cases in which it did very closely simulate it, the niche-like deformity being quite constant. The point that was brought out just a moment ago is very true indeed, that if accompanying signs are absent, such as induration, or the spasm opposite, one has to be exceedingly cautious in making a diagnosis.

Dr. Bettelheim. Most of the conditions which can imitate a niche were known to Haudek shortly after the discovery of the "niche" symptom. They are mostly jejunal coils which when lying on the smaller curvature will be interpreted as "niche;" when on the major curvature as "niche" or diverticulum of the stomach. But most of these diagnoses will be made from plates made by the technician when the roentgenologist did not even see the patient. Technicians have a very defective idea of the way that the niche originates. Haudek himself does not trust to make the diagnosis of niche from an *x*-ray plate for the simple reason that the picture seldom discloses anything about the origin of a shadow. You know that the discovery of the niche symptom was made by a school which uses mostly fluoroscopy for *x*-ray diagnosis; and, like its discovery, so the correct interpretation of it is not possible without the use of fluoroscopy.

We must see from which organ and from which source the shadow comes. Shadows of concrements in the kidneys, pancreas, mesenteric glands and the intestinal wall have their characteristics also on the plates, but they will be recognized with certainty only when they are localized on the plate, or even better, on the screen before the stomach has been filled. The coils of small intestine filled with contrast material have characteristic outlines also on the plate on account of Kerkrings folds, but we can see with more accuracy on the screen the contrast meal being pushed forward in the intestine and before this stage how the outlines of the stomach can be discerned in every direction under the fluoroscope. This is the only method of examination that assures us whether the shadow originates in the stomach or in the duodenum. After all the intestines are filled, even the anatomical orientation becomes extremely difficult, as is known by all who practiced the examination of postoperative stomachs. Coils of intestines containing gas can also throw peculiarly outlined shadows, as is also known to all by personal experience.

The traction diverticula caused by perigastric adhesions can be distinguished from the niche shadow with much greater difficulty, but this should be not of too great importance if we consider that the circumscript perigastritis is mostly the consequence of an ulcerous disease of the stomach wall.

I have but to mention that an eventual bulging out of the stomach shadow may occur on account of the anatomical structure of the wall of the stomach, especially distally from the cardia and angulus ventriculi on the smaller curvature.

Thus the niche symptom remains the most valuable and certain *x*-ray sign of ulcer of the stomach or duodenum when carefully examined and interpreted.

Dr. Gottlieb, New York. Last spring it was my privilege to attend the German *X*-Ray Clinic in Munich, and a paper was presented which was very similar to that of Dr. Bassler, and it aroused a great deal of discussion.

Another gentleman prepared a paper in which he proved that he could produce the niche, make it disappear, and produce it again in the same day, and Dr. Haudek then admitted himself that a bulge, a persistent, teat-like bulge, on the lesser curvature is not always an ulcer; he didn't know just how to differentiate it, he has found a number of cases like that, and I really thought Dr. Bassler was in collusion with him when I heard the paper.

Dr. Bassler (closing). When I read that paper I really couldn't help but smile, because I left myself so open to criticism in a way.

But nevertheless, gentlemen, it is true that diagnoses of ulcers are being made on a simple bulge on the lesser curvature. And I would say that I think you gentlemen who represent this national organization should use the terms "true" and "false" niches. There seems to be a great laxity in this, and those two terms would help to clear it up.

Another thing,—the literature on niches is brought together in this article,—and we, after writing to the various prominent roentgenologists throughout the world and getting answers, found that they knew of one paper by Haudek and one paper by So and So, and that there are really 47 papers in the literature of the world on the niche,—I thought that it was time somebody did that. Haudek himself admits to 5 per cent of failure, back as far as 1910. I admit to about 10 per cent of failure in definite niches, no ulcer being present. We take about 15 films of every stomach. I feel definitely as a clinician who has an expert roentgen department, that unless there are some symptoms of stomach trouble, I hesitate to make a diagnosis of ulcer on the niche alone, and I admit to not being clever enough with my fingers, and otherwise, to tell always that there is a callus surrounding it.

I feel that this Society likewise should teach the dictum to clinicians that the absence of this bulge is not proof conclusive that the ulcer is cured. I am seeing the fallacy of this all the time, and I am very glad that in the discussion this point was again brought out.

I am sorry that Dr. Cole has taken that position. He is so serious about everything that he didn't at all catch the point of my contribution. What I wanted to bring out to you is this, that diagnoses of ulcers are being made on these bulges that are not true niches and they are sending them in to me and to surgeons as ulcers on that simple bulge. Tests of medical cures are being proven on the bulge present at one time and not there at a future time. And I again ask you to make it your business that a true distinction be broadcasted between false and true niches, because if I have done nothing else today but that, I feel that I have rendered a service,—a crying need in the roentgen diagnosis of this thing today, as it is being carelessly conducted, at least in my part of the country, which is New York.

Dr. Doub (closing). My paper was not primarily in regard to spasmodic types, so I will say nothing more about that.

With regard to the question Dr. Cole brought up, I will say a word concerning the sleeve resection operation which I gave the impression of condemning. I think that that probably is a very good operation, providing there is a competent surgeon doing it, and providing the patient is in sufficiently good physical condition. Unfortunately, in some places patients are operated upon without putting them in the proper physical condition. I believe if a patient were hospitalized, or put under very good medical management, and in good condition, possibly that operation would be applicable to a much larger percentage of cases than the more simple operation of gastrogastrostomy or gastroenterostomy.

An educated man knows when a thing is proved and when it is not. An uneducated man does not know. Lord Morley.

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Information of interest to all readers will be found on page i. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

PLANS FOR THE FUTURE OF THE JOURNAL

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY enters, with this issue, upon a new era, in that it will henceforth be greatly enlarged and will be published in two volumes annually instead of one.

The larger size of the JOURNAL makes it necessary to increase the subscription price, and in this connection we wish to bring to the attention of our readers certain considerations with regard to the value of the Journal.

The new editor has already received criticisms of the JOURNAL like the following: "Please discontinue my JOURNAL; it contains entirely too many radium articles." Another writes, "Discontinue my Journal. I am interested in therapy and find only diagnostic articles in it." Another writes, "The Journal is entirely too 'high-brow'"; while still others have suggested to the editor that he really must raise the scientific standard of the articles.

These comments seem to the editor to indicate an extremely narrow view of the place to be filled by medical journals in general and by ours in particular.

Medical literature may be divided into two classes: First, that which is of immediate and perhaps only temporary value and which should be read in its entirety; second, that which is in the nature of research and is of value only for reference.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY hopes to make a definite place for itself in both of these branches. The articles which today are passed over as of no practical worth may be the very ones which will give to the JOURNAL files their permanent value and make them invaluable for reference in the future.

What applies to this journal applies, after all, to every branch of medicine. What we wish to emphasize is that a medical journal is not to be placed in the class with the daily newspaper, which is discarded as soon as read. The medical journal is even more justly entitled to a permanent place in every medical library than are the textbooks which become out of date and are replaced by new ones almost from year to year. Medical periodicals are the backbone of the public medical libraries and are the original sources from which textbooks are compiled. The roentgenologist, therefore, who reads what he finds of immediate interest when his journal arrives and then carefully files it to be bound with its index when the volume is complete, will soon find that he possesses a valuable reference library on roentgenological subjects.

It is the editor's care to have in each number at least *one* article of interest to all readers. To make every page of every number of equal interest to every reader is a Utopian dream that the editor does not hope to realize.

It may not be amiss, therefore, to point out to our readers that books of the size of a volume of the JOURNAL would cost more than an annual subscription to the JOURNAL. We fully believe that the reading done from month to month will be of more value than the subscription price, and that the large amount of material so valuable for reference is really a "bonus" received with the subscription.

In carrying out the new plans for the JOURNAL the editor very earnestly asks the support and help of all the old subscribers, and hopes that the JOURNAL will attract to become its supporters a large number who have not heretofore realized its value in their work.

DR. H. M. IMBODEN OUR RETIRING EDITOR

The following resolution was passed at the Twenty-fourth Annual Meeting of The American Roentgen Ray Society:

"Five years ago the American Roentgen Ray Society, realizing that the continuance of its official publication was a necessity for the best interests of the society, and with the full knowledge that the editor was the most important factor in maintaining the high standard of its publication, chose Dr. Harry Imboden as editor-in-chief.

"The continuance of the high standard of the articles selected and published, the progressive growth and the attainment of the enviable position of the American Journal of Roentgenology, so that it has come to be regarded as the leading journal in the roentgen publications of the world, has shown the wisdom of this choice.

"With a full realization of their debt, the members individually and collectively extend to Dr. Imboden their thanks and appreciation of his valued work, characterized by untiring efforts and conscientious sacrifices.

"In order to perpetuate this appreciation, it is resolved that these words be spread on the minutes of the meeting and that an engrossed copy be sent to Dr. Imboden."

This resolution indicates in only small measure the respect and affection in which Dr. Imboden is held by the members of The American Roentgen Ray Society. Everyone remembers that he assumed the duties of Editor of the JOURNAL in a sudden emergency during the World War and that he maintained during that trying time the high standard set for it by its previous editors. The members of the Society wish to make public acknowledgment of their gratitude to Dr. Imboden for the service that he has so rendered, and also of their appreciation of the sacrifices entailed by his duties as editor.

THE CALDWELL LECTURER FOR 1923

We are publishing in this issue a portrait of Dr. Percy Brown, one of the oldest members and a former President of the American Roentgen Ray Society, and one of the pioneer roentgenologists of this country. He was the Caldwell Lecturer for the year 1923. It seemed particularly appropriate that one who was a close personal friend of Eugene Caldwell and who has suffered in the same cause, should have been chosen to deliver this lecture, which is given annually in honor of one of the martyred members of our Society.

It gives us great pleasure to make it possible for Dr. Brown's many friends to secure this excellent portrait.

RADICALISM VERSUS CONSERATISM IN RADIUM THERAPY

The history of medicine is full of examples of the universal law of action and reaction. Only a few years have elapsed since surgeons were wont to concentrate their attention on the lesion and to direct their efforts towards its eradication, while the patient received scant consideration. Excessive mortality rates soon forced the more radically minded to change their tactics, and common sense is now in a fair way of being restored.

During its relatively short existence radium therapy has passed through much the same, though somewhat attenuated, phases. However, it is now generally recognized that to cure the lesion and kill the patient is neither advancing medical science nor contributing to the sum of human happiness.

The decision as to how radical the treatment in a given case should be must depend on the condition of the patient quite as much as on the character, size, location and distribution of the lesion treated. For instance, in carcinoma of the cervix, careful general examination will usually enable the radiologist to classify such cases into two main groups: (1) those in whom anything approaching cure is out of the question, and (2) those in whom permanent cure may conceivably be expected.

In dealing with patients in the first group the object must be to obtain the maximal degree of improvement possible, while avoiding any measure that may sap the patient's strength or increase existing disability. This object is best fulfilled by adopting a conservative course.

In patients of the second group reasonably radical measures are indicated. It is well known that unless all the cells of a malignant tumor receive a lethal dose at the outset, some of them will in time recover their power to grow and ultimately will kill the patient; the initial attack must therefore be carefully planned and thoroughly executed. Unless the technique be sound and the first attempt at treatment thoroughgoing, no amount of subsequent therapy will yield the result that might otherwise be obtained.

The same principle applies to malignant lesions elsewhere in the body. To be effective, every therapeutic measure must be based on intelligent understanding of the lesion against which it is directed. "Shot-gun radiology" is no better than the "shot-gun" prescriptions in common use twenty years ago.

As roentgenologists, many of us have allowed ourselves to become so engrossed in the study of shadows that we have all but lost the sense of reality. Recent increments to our knowledge of the physical aspects of roentgenology have caused many of us to direct so much attention toward physics that we have almost forgotten that we are primarily physicians. It is a fact, however, that physical knowledge in the roentgenological field has far outdistanced our knowledge of the pathological conditions in which radiation is therapeutically employed. For the time being it would seem that physics may safely be left to the physicist while we resume the study of pathology and clinical medicine.

A. U. Desjardins, M. D.

RADIATION TREATMENT OF CANCER

Since the action of the roentgen rays upon new-growth cells was first observed, continuous efforts have been made to treat successfully various forms of cancer. The degree of success achieved has varied with different workers.

Quite recently the treatment of cancer by the roentgen ray has received fresh stimulus from the published results of several workers on the European continent, and all over the world roentgenologists have tried to repeat these results, using in many instances the same form of apparatus and tubes, and as nearly as possible the same technique as that described by the continental workers. In view of the conflicting opinions held by many roentgenologists and clinicians, the present is an opportune time to review the questions of radiation treatment of cancer and other forms of malignant growth.

The discussions on this subject at the annual meeting of the American Roentgen Ray Society last September showed a tendency toward caution rather than optimism. This indicates the inevitable recoil following upon the extreme optimism initiated and sustained by the publication of results claimed to have been made by several workers on the Continent of Europe. It also indicates that time enough has already elapsed for many workers to try the newer techniques, and to ascertain for themselves the value of the treatment.

There can be no doubt that the hope of curing cancer by the more intensive treatment made possible by the production of more powerful apparatus and of tubes capable of sustaining the high potential current induced many workers to enter the field and to treat cases with greater enthusiasm than judgment, the consequence being that disastrous results often ensued.

The fact stands out clearly that a great advance in technique has been made, and it would be unfortunate if the value of this advance should be lessened by the misguided enthusiasm of inexperienced workers. Such results seem usually to follow the advent of a new therapeutic agent, or the improvement of an existing one. Koch's discovery of the tubercle bacillus and a serum to combat it led to equally extravagant hopes, which in the subsequent development of the method were not realized. The introduction of salvarsan led to great hopes in the treatment of syphilis, many of which have not been fulfilled; and disasters were not uncommon in the earlier exploitation of the method.

The appearance of any treatment claiming to be a cure for cancer cannot but be subjected to the same alternating fluctuations of hope and despair. Let us, therefore, be very guarded in the expression of views which at present can only be speculative. A disease whose cause is as yet undetermined, in all probability cannot be cured by any treatment which is founded upon empiricism.

Until we know more of the intricate changes in cell growth, it will be useless even to contemplate the possibility of a specific cure for cancer. A great deal of experimental work must yet be done before the biological processes of cell growth can be understood.

It is apparent that in the study of cell growth, radiations may help materially to clear the ground for further great advance. It is significant that a number of the leading cancer research workers are turning their attention to the biological processes in an endeavor to elucidate the problem. Of these the works of Fibiger, Leitch, Murray and Drew are particularly interesting. Drew's observations in relation to tissue changes occurring in cultures in vitro are of special interest to the radiologist. He concludes a paper with the following:

"The activating substances in autolyzed extracts of normal adult tissue and their absence in embryonic tissue extracts shows that they are undoubtedly the same agents which are met with in the phenomena of repair. Their presence in cold extracts of the malignant tumor suggests that it is by means of a continuous production of these substances that tumor growth is maintained and constitutes a new and very striking difference between tumors and normal tissues, the former containing the growth-stimulating factors, while the latter require to be severely damaged before they are produced. The fact that the highly malignant and rapidly growing tumors contain a far greater amount of such growth-activating substances than do the slowly growing and more benign, reveals a quantitative relation, which has not before been demonstrated in the analysis of tumor growth."

In regard to the growth of a culture of sarcoma, he makes the following significant observations: "It is evident that 37 S in culture produces some substance which is toxic to itself, and can inhibit growth in vitro; this substance is evidently not toxic to culture of heart cells. Heat at 60°C., for half an hour, destroyed its toxicity."

Observations such as those of Drew, Murray and Leitch on the process of development of tumors indicate the lines upon which observations on radiation effects should proceed, and point to the need of extreme caution in the handling of agents which are likely to interfere seriously with the natural processes of repair.

The patient should be the first consideration in all attempts at cure by radiations or allied measures. Treatment should be made on rational lines, which are evolved from a consideration of physiological and pathological processes. If a very long exposure is contemplated, then all steps should be taken to ensure that the patient is in a fit condition to stand the strain. A careful consideration of the pathological processes at work, the condition of the tumor, the type of cell composing the bulk of its structure, and also that of the surrounding tissues, will in a number of cases rule out at once any hope of a cure. The treatment must then become palliative, and in this group there is a large field for the roentgenotherapist.

In an inoperable case of cancer combined treatment is the most rational procedure, and in such a combination it will be found that the use of the diathermy current is invaluable. Many cases, apparently hopeless from the point of view even of relief, have made startling progress, when treated rationally by an experienced roentgenologist. Radium and roentgen rays are very valuable adjuncts to diathermic cauterization. The latter agents in carcinoma of the cervix often give most brilliant results when either alone will fail. Radium is the best agent we possess for the local treatment of the disease.

The successful treatment of malignant disease requires a much more comprehensive regime than that of radiation alone. Much of the value of the treatment by such means is lost by the failure to realize that we are dealing with a patient and not with a purely physical problem. Dietetic and drug treatment are of value, and above all the environment of the patient must influence all effort to cure him. Combined treatment is clearly indicated in many of the cases of malignant disease, and such treatment must include the cooperation of the surgeon and the radiologist. The former, by a modified operation, will in many instances greatly add to the prospect of relief or cure, while in the technique of radium therapy a most complicated operation may be the necessary precursor to the insertion of radium tubes into the substance of a growth. Again, after radiations and other methods have accomplished all that is possible, the surgeon may by a plastic operation complete the cure.

Preoperative and postoperative treatment will also have a profitable place in the treatment of malignant disease. It is apparent that with the ordinary technique of roentgen therapy in its application to the treatment of disease, great skill is necessary before even temporary results are obtained. Skill without judgment in application is useless, and the exercise of the latter demands a most thorough knowledge of all the factors, and of the probable effects upon the living organisms.

We would urge most insistently that an estimation of the value of the so-called "deep therapy" can only be arrived at after most exhaustive research work in all directions. Such work will necessitate the collaboration of many experts in the various fields of research.

Robert Knox, M.D.

SUGGESTIONS FOR ADDITIONS TO THE ROENTGENOLOGIST'S LIBRARY

The rapid developments in the field of roentgenology and radium therapy are making it increasingly important for the radiologist to have the preliminary education and training, the wide clinical experience and the general culture that comes from reading, that are necessary in the development of every broad-minded physician.

The radiotherapist who hopes to be more than a mere technician must have a thorough knowledge of the pathological anatomy and the usual clinical course of the diseases he treats, and, moreover, must keep thoroughly informed of advances in knowledge of these diseases. This necessitates constant studious reading.

No one who is treating cancer by whatever means, can afford to neglect reading the second edition of Handley's book on "Cancer of the Breast and its Treatment," which is reviewed in this issue of the Journal and which Knox quotes in his article, also published in this issue. We recommend also the book of Bland-Sutton on "Tumours Innocent and Malignant. Their Clinical Character and Appropriate Treatment' (reviewed on page 95 of this issue). Other books that, in our opinion, should be in the library of the radiotherapist are "Neoplastic Diseases" by Ewing, "The Breast; Anomalies, Diseases, Treatment" by Deaver and Macfarland, and "Radium Therapy" by Simpson. The latter was reviewed in the Journal for June, 1923, p. 458.

Subscribers to The American Journal of Roentgenology and Radium Therapy *visiting New York City, are invited to make the office of* The Journal *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospiatls on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Annual Meeting of the Southern Medical Association, Washington, D. C., Nov. 12–15, 1923.

The annual meeting of this association is one of the largest and most important medical gatherings in this country. There were over twenty-three hundred registrations at this year's session. The President of the Association, the Section Chairman and others who assisted in arranging the program and the local committee of entertainment all deserve great credit for a most successful meeting.

The first General Session at this meeting was notable for inspiring and instructive addresses and orations, among which were the President's address on "Modern Problems of Preventive Medicine" by Dr. W. S. Leathers of University, Miss., and an address by Dr. George E. Vincent, President of the Rockefeller Foundation, on "Medicine as an International Influence."

At the concluding General Session Dr. Charles Minor of Asheville was elected President of the Association for the ensuing year.

The scientific program is conducted by nineteen different sections and subdivisions and an attempt will be made here to summarize briefly the work in the different sections that is of especial interest to roentgenologists and radium therapists.

The Radiological Section met on two succeeding afternoons under the chairmanship of Dr. David Y. Keith of Louisville. Dr. Keith in his Chairman's Address spoke on the subject of "Roentgen Aid in the Acute Abdomen," and emphasized especially the diagnosis of acute obstructions, diaphragmatic hernia and subphrenic abscess. Dr. Robert H. Lafferty read a comprehensive paper on the roentgenology of the urinary tract, and Dr. John J. Shea of Memphis, Tenn., presented a very interesting paper on the development of the nasal accessory sinuses in the embryo and infant, followed by a discussion of the value of roentgenology in the diagnosis of sinus diseases in the child and adult. He showed especially the value of roentgenograms as a guide in operations on the sinuses. The second session of the Radiological Section was given over to papers on roentgen therapy. Dr. Howard E. Ashbury gave an instructive paper on "A Practical Method for the Application of *X*-Ray Dosage." Dr. E. C. Ernst, in a paper on "The Management and Measurement of *X*-Ray Radiation in Deep-Seated Malignancies," gave some recent dosage methods, with comparison of effects with different filtration. Dr. J. M. Martin showed the curative effect of the roentgen ray in malignancies of the face by often-repeated doses through moderate filtration, and Dr. S. S. Marchbanks of Chattanooga gave a good paper in which he emphasized the necessity of keeping in mind the fact that radiation not only has an effect on the malignant disease but that it also has a general effect on the patient which may defeat all our well-intended efforts; the welfare of the patient must be the first consideration rather than simply the cure of his malignant disease.

The Radiologic Section at its final session elected Dr. W. R. Bethea of Memphis, Tenn., as Chairman for the ensuing year.

The Southern Gastroenterological Association meets as a section of the Southern Medical Association, and at its sessions were presented addresses and papers of much interest to roentgenologists. Dr. F. H. Baetjer gave an address as a part of a Symposium on Intestinal Stasis on the subject "The Roentgen Ray in the Diagnosis of Chronic Intestinal Stasis." He emphasized the fact that the clinical significance of the roentgen findings in any given case must be interpreted with the help of a knowledge of the habitus of the patient. A delay which might be of significance in a patient of the sthenic type would be negligible in a person of the asthenic type. Dr. Russell Verbrycke read a paper in this section on "Chronic Duodenal Stasis," giving, among the causes of this condition, aberrant blood vessels causing angulation, adhesions of the duodenum arising from the gall-bladder, congenital veils and adhesions, etc. Dr. E. C. Samuel read a paper on "Deep *X*-Ray Therapy of Peptic Ulcer" in which he cited the fact that numerous papers have been published during the past year, especially in the German literature, which recommend roentgen therapy for the treatment of gastric and duodenal ulcer. He shows convincingly by a report of such cases treated by him according to the published technique, and subsequently operated upon, that the roentgen treatment has no curative effect.

The Section on Bone and Joint Surgery had many interesting papers, nearly all of which were illustrated by roentgenograms. We hope to publish a special review of these papers in a future number of the Journal.

At the meeting of the Southern Medical Association last year and again this year the Surgical and Radiological Sections had a joint dinner followed by addresses on a subject of interest both to surgeons and radiologists. Last year the subject was "Hyperthyroidism" and Dr. G. W. Crile presented the surgical side of its treatment and Dr. George Holmes discussed its radiological treatment. This year the subject was "Radiation in the Treatment of Cancer of the Breast with Special Reference to Radiation Before and After Surgical Operation." Dr. W. E. Sistrunk of the Mayo Clinic presented the subject from the surgeon's standpoint and Dr. George E. Pfahler from that of the radiologist.

Dr. Sistrunk said that in early cases, without glandular involvement, radical operation cures about 64 per cent of the cases operated upon but that after axillary gland involvement they had had only 19 cures out of 132 cases. He emphasized the necessity for extending the time for reporting cures to five years or even more because of the considerable number of cases that recur up to and even beyond five years. He recommends both preoperative and postoperative radiation of breast cancer but is not prepared to say just how soon radiation should be given after operation. He does not believe that radiation treatment results in complete cure of breast cancer, and he showed several slides illustrating this point. Some of these were photographs of patients with local recurrence and metastases after thorough radiation, and others were photographs of removed breasts showing cancer still present surrounded by fibrous and hyaline changes. He referred to McCarthy's work in which he had shown that at the periphery of a growing carcinoma there is a zone of fibrous and hyaline changes, and leucocytosis. He believes that radium and the roentgen ray may exert their beneficial effect by simulating nature's method, since it is known that the rays do produce these effects.

Dr. Pfahler called attention at the beginning of his address to the fact that the types of breast carcinoma which are easiest to deal with surgically are likely to be those most resistant to radiation treatment; the medullary type of cancer may yield readily to radiation while the scirrhous type is usually very resistant. He also referred to experimental work that has definitely proven that radiation of carcinoma before it is inoculated into healthy animals prevents its growth in a large majority of instances, and to other experiments which show that radiation of animals before the inoculation of unradiated carcinoma will also prevent the growth of the carcinomas. These two sets of experiments furnish conclusive proof that irradiation not only has a deleterious influence upon the cancer cells but that it also has some influence upon the healthy tissues which prevents the tumor growth. Dr. Pfahler presented a great number of cases illustrated by lantern slides which showed in a very convincing way the value of irradiation not only as a preoperative and postoperative measure, but as the sole treatment in inoperable cases.

Both of these papers and also those mentioned previously in this brief review will be published later in the Southern Medical Journal and abstracted by us.

PRELIMINARY PROGRAM OF MID-WINTER MEETING EASTERN SECTION A. R. R. S.

CHALFONTE-HADDON HALL, ATLANTIC CITY, N. J., JANUARY 24, 25 AND 26, 1924.

THOMAS A. GROOVER, M.D., *President*

Experimental Studies on X-ray Effects. James B. Murphy, M.D., New York.

The Diagnosis of Primary Intrathoracic Neoplasms. Geo. F. Thomas, M.D., and H. L. Farmer, M.D., Cleveland.

A Stereoscopic Film Changer for the Upright Thoracic Position. Especially Designed for the Rapid Handling of Heavy Cassettes and Embodying Other New or Hitherto Little Used Principles. David R. Bowen, M.D., Philadelphia.

Lateral Roentgenography of the Lumbo-sacral Region. L. T. LeWald, M.D., New York.

Atelectasis as a Roentgen-Ray Sign of Foreign Body in the Air Passages. W. F. Manges, M.D., Philadelphia.

Case History—Fibroid Goiter Completely Cured by X-ray through Open Wound. Previous Diagnosis of Malignancy. W. E. Reilly, Clearfield, Pa.

The Roentgen Ray in the Treatment of Cellulitis and Other Acute Lymphangitic Infections. F. M. Hodges, M.D., Richmond Va.

(*Title to be announced.*) William Duane, Ph. D., Boston.

(*Title to be announced*). R. H. Stevens, M.D., Detroit.

Blood Types in Relation to Carcinoma and Its Treatment by Radiation. G. E. Pfahler, M.D. and B. P. Widmann, M.D., Philadelphia.

The Study of the Sternum by Roentgen Rays (Lantern Slides). G. E. Pfahler, M.D. Philadelphia.

Roentgen-Ray Treatment of Keloids. H. H. Hazen, M.D., Washington.

Roentgen Findings in Some Unusual Lesions of the Gastrointestinal Tract. W. H. Stewart, M.D., New York.

(*Title to be announced.*) Burton J. Lee. M.D., New York.

Description of Fracture Tables. H. K. Pancoast, M.D., Philadelphia.

Preliminary Report on the X-ray Treatment of Amoebic Colitis and of Wassermann-fast Lues. Samuel Stern, M.D., New York.

X-ray Study of a Case of Leukosarcoma (Sternberg). Sherwood Moore, M.D., St. Louis.

Two-minute Demonstration on Use of Ryan's Rule—A Convenient Instrument for Treatment. A. H. Pirie, M.D., Montreal.

Radiography of the Mastoid Process. Isaac Gerber, M.D., Providence.

Cases of Chronic Tonsillitis and Pharyngitis in Which X-ray Therapy is Indicated. W. H. Witherbee, M.D., New York.

The Differential Diagnosis between Cardiac Enlargement and Pericarditis with Effusion (Slides). Berton Lattin, M.D., and C. Winfield Perkins, M.D., New York.

A Brief Report of Two Urological Cases. R. H. Lafferty, M.D., Charlotte, N. C.

The Value of Deep X-ray Therapy in the Treatment of Carcinoma of the Bladder. Chas. A. Waters, M.D., Baltimore.

Diagnosis of Aneurysm of the Aorta. E. C. Samuel, M.D. New Orleans.

Mixed Radiation in the Treatment of Neoplasm, with Report of Cases. D. Y. Keith, M.D., Louisville.

Lung Tumor with Symptoms Referable to the Right Upper Quadrant of the Abdomen. H. M. Imboden, M.D., New York.

Some Considerations in the Treatment of Carcinoma of the Esophagus. Douglas Quick, M.D., New York.

Massive Collapse of the Lung. Geo. W. Holmes, M.D., Boston.

(*Title to be announced.*) John Remer, M.D., New York.

(*Title to be announced.*) H. J. Walton, M.D., Baltimore.

Roentgen-Ray Studies in the Feeble Minded. M. W. Clift, M.D., Detroit.

Palliative Doses of X-ray in Advanced Cancer. Eugene Leddy, M.D., and J. L. Weatherwax, Ph. D. Philadelphia.

Traumatic Hernia of the Diaphragm. F. F. Borzell, M.D., Philadelphia.

Deep Therapy and Radium in Carcinoma of the Tonsil. G. W. Grier, M.D., Pittsburg.

The Role of Ligamentous Calcification in Lower Back Pain. Howard P. Doub, M.D., Detroit.

Further Studies of X-ray Penetration (to be read by title). J. L. Weatherwax, Ph. D., Philadelphia.

A Practical Method of Constantly Measuring the Radiation from an X-ray Tube with a Check against the Omission of Filters. J. L. Weatherwax, Ph. D., Philadelphia.

A Case of Hodgkin's Disease with Late Developments of Sacroiliac Disease Cured by X-ray Treatment. C. P. O'Boyle, M.D., Philadelphia.

Treatment of Bone Sarcoma—Case Report. Myron B. Palmer, Rochester, N. Y.

The Roentgenological Diagnosis of Craniopharyngeal Pouch Tumors. K. G. McKenzie, M.D., and M. C. Sosman, M.D., Boston.

The X-ray in the Treatment of Bone Tumors. R. E. Herendeen, M.D., New York.

MEETING OF CENTRAL SECTION

The Central Section of the American Roentgen Ray Society will meet at Indianapolis, Ind., Feb. 23, 1923. Members having new developments to present will be given opportunity at that meeting.

All subscribers of the JOURNAL, and those interested in roentgen work are invited to attend.

The program is well under way, and will include morning, afternoon and evening programs. A lantern-slide exhibit will be held at the evening meeting with film demonstrations of interesting cases. This should be more profitable than the lantern-slide show. For further information in reference to the program please write:

Dr. D. Y. Keith, Louisville, Ky., Chairman.
Dr. Raymond C. Beeler, Indianapolis, Ind., Secy.

"In popular writing it seems to be necessary to link every great discovery, every new theory, every important principle, with the name of a single individual. But it is an almost universal rule that developments in physics actually come about in a very different way. A science, like a planet, grows in the main by a process of infinitesimal acretion. Each research is usually a modification of a preceding one; each new theory is built like a cathedral through the addition by many builders of many different elements." *The Electron.* Millikan.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

A STRETCHER UNIT FOR THE ROENTGENOSCOPIC EXAMINATION OF BED PATIENTS

PLANNED ESPECIALLY FOR PULMONARY CASES

THE diagnosis of various chest conditions, particularly pleural and pericardial effusion, and the examination of cavities, especially abscess cavities, demand some position in addition to the supine or prone recumbent position. Most postpneumonic complications occur in patients too ill to assume the erect posture. For these the anteroposterior or posteroanterior projection with the patient lying on the unaffected side, will afford practically all the information to be secured by the erect posture. For instance, the homogeneous shadow of a half-filled abscess as seen with the patient supine or prone becomes so changed in this lateral posture as to give positive information, if, as often occurs, we find a distinct fluid level. Instances may be multiplied, but the present object is to exhibit the method rather than to discuss its uses.

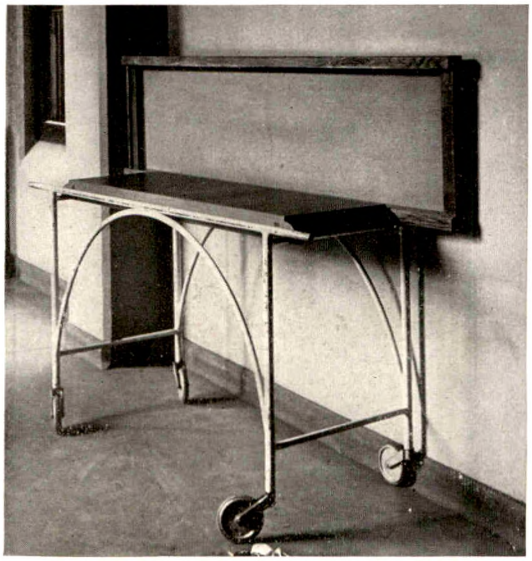

FIG. 1. A stretcher unit showing the carriage, stretcher and wooden platform.

The unit as illustrated consists of three parts:

(*a*) An oak frame, canvas-top stretcher, shown here as turned, edge upward, against the wall (Fig. 1).

(*b*) A light but firm wood platform, usually kept in the roentgenoscopic room, but here shown, as used, on the carriage.

(*c*) The carriage. This must be so constructed as to permit the use of parts (*a*) and (*b*), and with no wheels or bars to interfere with its use in front of a vertical or tilting roentgenoscope.

The carriage, with stretcher upon it, is taken to the bedside and the patient thus removed to the roentgenoscopic room. Without removal of the patient from the stretcher, the horizontal position study is made. The platform (*b*) is then placed on the carriage under the stretcher supporting the patient. This has the effect of placing the patient on a firm, unyielding table so that there is a complete support level with the stretcher top, quite rectifying the sag of the canvas.

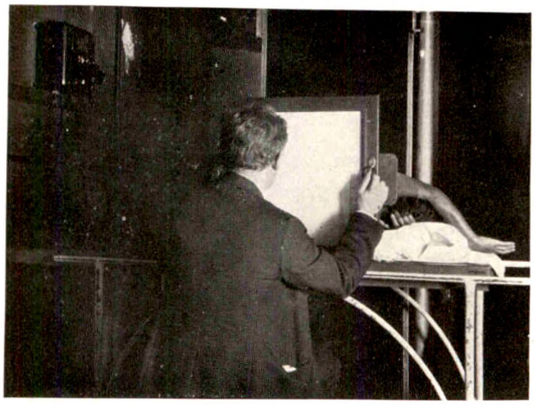

FIG. 2. Special stretcher in use before vertical roentgenoscope.

On this the lateral position study is made (Fig. 2). If the disease is wholly unilateral, and if the patient can without serious difficulty lie on the unaffected side, the platform (*b*) may often be omitted; its sole use is to prevent the sag of any part of the patient's body below the upper level of the stretcher frame. A light wooden frame with iron handles at each corner may be substituted, if desired, for both the wooden platform and stretcher.

With most, perhaps all, types of the tilt-table roentgenoscope, it will be necessary to remove the screen ordinarily used and to use a larger screen which is not connected with, and does not move with the tube; this is for the obvious reason that the arm carrying the attached screen will come in contact with some part of the patient's body and thus prevent lowering of the screen to the level where the pathological condition can be visualized.

AN AID FOR THE SORTING, REPORTING AND FILING OF FILMS

THE handling of yesterday's films during the period of reporting and filing became, in our department, a matter of much inconvenience. In early years these were displayed upon a large illuminating box, but the work grew and the box did not; nor could room be spared to add further illuminating space. Therefore, the device here described came out of necessity. It has proven so satisfactory that neither our own personnel nor the hospital staff would care to return to the former method.

A box (Fig. 1) is provided, 18½ in. long, 14 in. deep, and 12 in. wide, mounted on legs and roller-bearing casters which raise its top to the total height of 34 in. Within are 100 pressboard guides 14¾ in. high and 18 in. long, which are numbered in one corner from 1 to 100. Tabbed cards might be preferred by some, but we have found these plain cut ones with Dennison sheet consecutive numbers pasted on, to be very satisfactory. For each guide card there is a manilla folder 14 × 17 in. in back and 14 × 16½ in. in front.

Suppose that the day's work begins with 36,624 and ends with 36,682; the films will be filed from 24 to 82 and, for the time, the 366 is disregarded. The next day's work will run from 36,683 to, say, 36,736. In the same way they will be placed from 83 to 100 and from 1 to 36. In the meantime, of course, folders 24 to 36 must have been filed.

Suppose in the first case—24 to 82—that 36,654 and 36,663 are re-examinations. Before the daily reporting begins the previous films will have been brought forward and put, with their respective folders, in the same number with yesterday's films of the same patient. When filed, the whole is kept with the new number. This has, it is true, the fault that there is some waste space in the older boxes, but this is more than compensated for by the saving in time when all the films of one patient are needed for comparison or study.

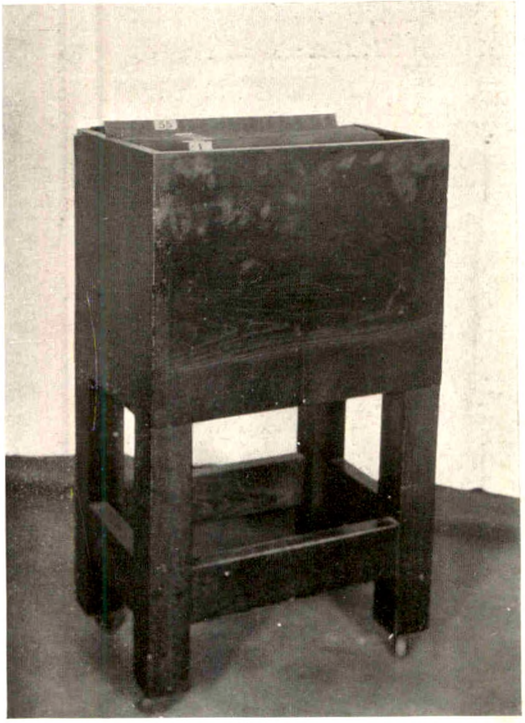

FIG. 1.

The illustration shows No. 55 card raised. In use this does not occur, but is so pictured to show that No. 55 is out;

and its folder is left partly out to indicate this.

Some saving in space could doubtless be made by using a combination guide card and folder, i.e., a single sheet of manilla folder could be attached, with a muslin hinge, to the guide card.

Being mounted on easy running casters, the box is readily available in the drying room for sorting, by the stereoscope for reporting and in the store room for filing. The device is not adaptable for plates and will be of less convenience in departments handling more than one hundred patients per day.

FURTHER REPORT ON A NEW TUBE HOLDER FOR ROENTGEN THERAPY

BY T. A. GROOVER, M.D., A. C. CHRISTIE, M.D., AND E. A. MERRITT, M.D.,

WASHINGTON, D. C.

OUR experience with the tube-holding device described by us in the July number of the Journal has been so satisfactory that certain improvements were made in order that minor defects might be corrected.

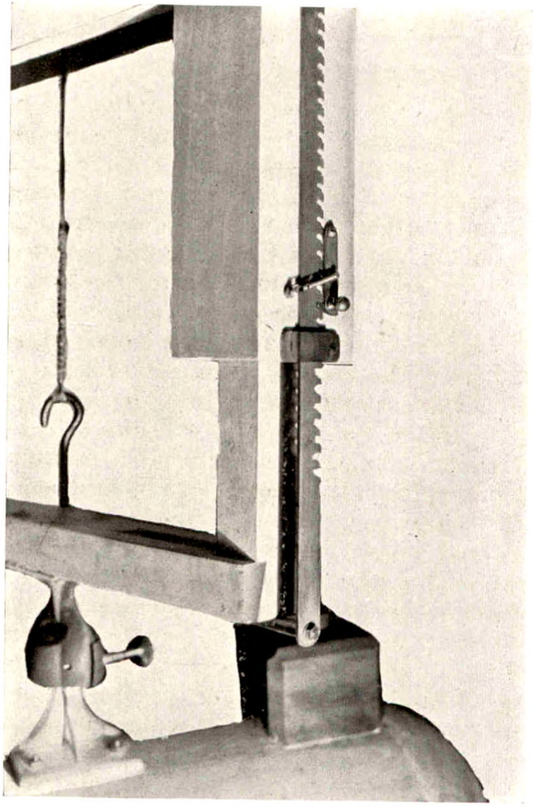

FIG. 1.

To overcome the danger from cable breakage, an automatic ratchet was fastened to one of the wooden tunnels; this ratchet engages by a spring mechanism as the tube is lowered or raised (Fig. 1). Its action is positive and it is sufficiently strong to support a weight many times as heavy as its normal load.

The second improvement was made in the cylinder itself. The present one is constructed of 16-gauge galvanized iron and covered with 4-lb. lead. The ends are concave and not lead covered. One end is closed permanently and the other supports a hinged door. The aperture in the side of the cylinder was increased to 5 in., and four metal lugs were soldered in the metal on the inside of the cylinder to hold filters in position. The door and lugs, with filter in place, are well shown in Figure 2.

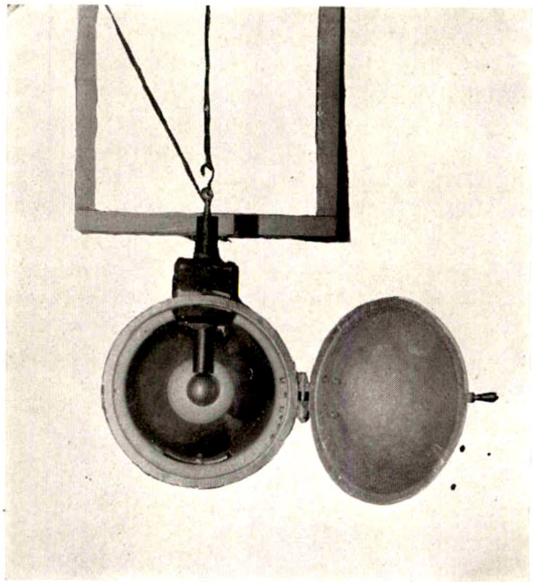

FIG. 2.

To the closed end a flexible metal tube, 2 in. in diameter, connects with an electric blower which maintains proper temperature and successfully eliminates ionized air.

Finally, the dimensions of the cylinder were changed to permit of using higher voltages and to facilitate removal of the tube. The present cylinder is 39 in. in length and 15 in. in diameter (inside measurements).

Figure 3 shows the entire device.

Our indorsement of this device is based upon a year's usage and the following features may be accepted as especially meritorious:

1. Elimination of danger from electrical shock and static discharge.
2. Protection from roentgen rays to the patient and the operator.

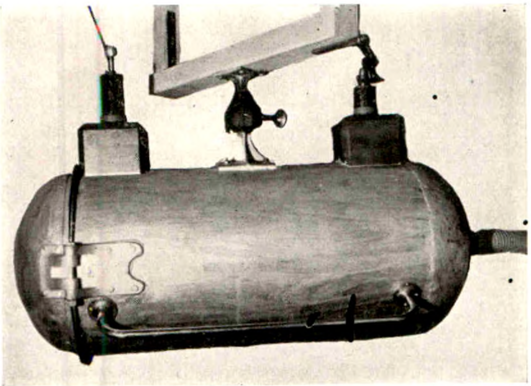

Fig. 3.

3. Ease of operation.
4. Impossibility of filters slipping.
5. Inexpensive construction.
6. Adaptability to space in room.

BOOK REVIEWS

Tumours Innocent and Malignant. Their Clinical Characters and Appropriate Treatment. By Sir John Bland-Sutton. Cloth. Price $7.50. Pages 783, with 383 engravings. 7th Ed. Paul B. Hoeber, Inc., New York, 1922.

This is the seventh edition of this excellent work on tumours. After an introduction dealing in a general way with the histology, age-distribution and the natural history of tumours, the author gives a concise description of each type of new growth. How completely this is done may be judged from the following partial list of subjects:

Group I. Tumour diseases of the connective tissues, including lipomas, tumours of bone, sarcomas of glandular organs, pigmented tumours, moles, neuromas, angiomas and lymphangiomas, uterine fibroids, etc.

Group II. Odontomes and dental cysts.

Group III. Epithelial tumours including papillomas, adenomas and carcinomas.

Group IV. Teratomas and dermoids.

Group V. Cysts.

Because of its compact form the book is an excellent one for reference with regard to the frequency, histology, location, and the surgical treatment of new growths. Only a few paragraphs are given to the subject of the treatment of malignant growths and of fibroids with the roentgen ray and radium.

Cancer of the Breast and Its Treatment. By W. Sampson Handley, M.S., M. D. Lond., F.R.C.S. Eng. Hunterian Professor of Surgery and Pathology in the Royal College of Surgeons of England; Surgeon to the Middlesex Hospital and to its Cancer Charity, and Lecturer in its Medical School. Cloth. Price $7.50. Pages 404, with 82 illustrations. 2nd Ed. Paul B. Hoeber, Inc., New York, 1922.

This is the second edition of this excellent book, which the author describes in the preface to the first edition as "an attempt to place the operative treatment of breast cancer, hitherto, in some respects, still empirical, upon a more complete rational basis." Much space is given to the elaboration and proof of the author's original theory that the dissemination of breast cancer is by continuous growth along the lymphatic channels instead of by embolism. In the preface to the second edition the author states that the "permeation" theory has won wide-spread acceptance. Certain it is that he marshals arguments and pathological evidence in its support that are thoroughly convincing.

This edition contains new chapters on Radiological Treatment, Recurrence and its Operative Treatment, Paget's Disease of the Nipple, Lymphangioplasty and Injury as a Causative Factor in Carcinoma.

The following recapitulation gives a very good idea of the special points in Handley's "permeation theory":

(*a*) Carcinoma spreads centrifugally in all directions from the primary growth by permeation of the lymphatic plexuses which lie upon the deep fascia.

(*b*) Curative, and reparative processes inadequate for cure, are a normal part of the cancer process.

(*c*) Processes of inflammation and fibrous tissue formation are the principal agents in the defense of the body against carcinoma.

(*d*) Invasion of the serous cavities by cancer-cells is an event of critical importance in the process of dissemination.

(*e*) The embolic theory of dissemination is true only for exceptional cases.

This book should be carefully read by everyone who treats cancer. It is written by a surgeon, but by one who makes large use of both radium and the roentgen ray, and the two latter are given separate chapters for their consideration; both are frequently mentioned throughout that part of the book devoted to treatment.

The Electron. Its Isolation and Measurements, and The Determination of Some of Its Properties. By Robert Andrews Millikan, Director of the Norman Bridge Laboratory of Physics, California Institute of Technology. Price $1.75. Contains 280 pages. University of Chicago Press, Chicago, 1923.

This is the Ninth Impression of this little volume which was first published in 1917. The general reader will find in it much that is interesting and instructive, but there are parts of it too technical in nature to be mastered by any but the trained physicist. Every roentgenologist should be thoroughly familiar, however, with the facts regarding the development of knowledge of the atom and electron here so interestingly set forth.

Not the least attraction of this book is its readable style. The author has the rare ability, possessed to so eminent a degree by Michael Faraday, of presenting scientific matters in a way to interest and instruct the general reader.

X-Rays. By G. W. C. Kaye, O.B.E., M.A., D. Sc., F. Inst. P. Price $5.00. 320 pages and 124 illustrations. 4th Ed. Longmans, Green and Co., London, 1923.

The physics of roentgen rays and their relation to other forms of radiant energy are described in this book in a simple way easily comprehended by the roentgenologist. The reader finds instructive chapters on the measurement of intensity and quality of roentgen rays, on scattered, characteristic and corpuscular rays, and on ionization by the roentgen rays.

Chapters of more general interest are those on "*X*-rays and Industry," "Diffraction of *X*-rays" and "The Nature of *X*-rays."

There is much historical information throughout the book to increase its interest and value.

The volume contains many tables and formulas which are valuable for reference.

Chronologia Medica. A Handlist of Persons, Periods and Events in the History of Medicine. By Sir D'Arcy Power, R.B.E., M.C. Oxon, F.R.C.S. Eng., and C. J. S. Thompson, K.B.E. Cloth. Price $3.50. 300 pages. Paul B. Hoeber, Inc., New York, 1923.

This little book does not purport to be a history of medicine but is actually a valuable reference handbook for names, dates and important events in medical history. In addition to a very complete biographical list of the noted names in medicine arranged chronologically, the book also contains a "Chronology of Drugs" and a "Chronology of Universities," together with an alphabetical index.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Medical Axioms, Aphorisms and Clinical Memoranda. By J. A. Lindsay, M.D., Price $2.25. 200 pp. New York: Paul B. Hoeber, Inc., 1923.

Diathermy and Its Application to Pneumonia. By Harry Eaton Stewart, M.D. Price

$3.00. 226 pp. with 45 illustrations. New York: Paul B. Hoeber, Inc., 1923.

Physiotherapy Technic. By C. M. Sampson, M.D. Price $6.50. 448 pp. with 85 illustrations. St. Louis: C. V. Mosby Co., 1923.

Radiodontia. By Howard Riley Raper, D.D.S. Price $4.50. 202 pp. with 52 illustrations. New York: Dental Items of Interest Publishing Co., 1923.

Interpretation of Dental and Maxillary Roentgenograms. By Robert H. Ivy, M.D., D.D.S., and LeRoy M. Ennis, D.D.S. Price $4.00. 200 pp. with 403 illustrations. St. Louis: C. V. Mosby Co., 1923.

Dental and Oral Radiography. By James David McCoy, M.S., D.D.S. Third Edition. Price $3.25. 197 pp. with 116 illustrations. St. Louis: C. V. Mosby Co., 1923.

Nosography in Modern Internal Medicine. By Knud Faber, M.D. Price $3.75. 235 pp. with 21 full page illustrations. New York: Paul B. Hoeber, Inc., 1923.

The Effects of Radium Upon Living Tissues. By Sidney Forsdike, M.D. Price $2.00. 80 pp. with 42 illustrations. New York: Paul B. Hoeber, Inc., 1923.

Chronologia Medica. By Sir D'Arcy Power, K.B.E. and C. J. S. Thompson, M.B.E. Price $3.50. 300 pp. with 84 illustrations. New York: Paul B. Hoeber, Inc., 1923.

"I hope the age has many who will follow his (Sydenham's) example, and by the way of accurate practical observation, which he has so happily begun, enlarge the history of diseases, and improve the art of physic, and not, by speculative hypotheses, fill the world with useless though pleasing visions. I wonder that, after the pattern Dr. Sydenham has set them of a better way, men should return again to the romance way of physic. But I see it is easier and more natural for men to build castles in the air of their own than to survey well those that are to be found standing. Nicely to observe the history of diseases in all their changes and circumstances is a work of time, accurateness, attention and judgment, and wherein, if men through prepossession or obstinacy mistake, they may be convinced of their error by unerring nature and matter of fact, which leaves less room for the subtlety and dispute of words." Quotation from John Locke in *Nosography* by Faber.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

Fox, Herbert, and Farley, Davis L. Effect of *x*-ray upon histology of nodes in some cases of lymphadenopathy found by adenectomy during treatment. *J. Radiol.*, Aug., 1923, iv, 261–267.

SUMMARY (ABBREVIATED)

"There are recorded in this article the outlines of 7 cases of lymphadenopathy composed of the following diagnoses: One case of Hodgkin's disease in the cellular stage, one case diagnosed as Sternberg's pseudo-leucemic tuberculosis, one case with great similarity to this last disease but classed as sclerosing Hodgkin's disease, a case of aleucemic leukemia or systemic lymphomatosis, a case of leukemia cutis with sublymphemic blood, one of aleukemic leukemia or reticulum sarcoma. These diagnoses are made on the basis of a classification used by Dr. Farley and myself and now in press (*Am. J. M. Sc.*) . . .

"Strict comparison of the effect of *x*-ray cannot be made throughout the 7 cases because of the different durations of the individual instances, the character of treatment it was possible to administer and the length of such treatment. The 7 cases, however, fall into three groups about which some general observations are permissible. The lymph cell and its congeners are definitely reduced while the endothelial and fibrous tissue cells instead of being limited in production, seem definitely stimulated to multiplication. It is also very certainly demonstrated that there is no return to normal architecture in glands under the action of *x*-ray and radium. There is greater evidence of phagocytosis by large cells with vesicular nuclei in tissues that have been rayed than in those removed before treatment. . . .

"We do not wish to draw final conclusions upon the action of roentgen rays on lymphadenopathies from these seven observations. This is, however, a considerable amount of material, since reasons for repeated adenectomy are not often at hand. We would, however, draw concluding attention to certain features which have stood out prominently in our material. The first of these is the character of fibroses in lymphogranuloma and the disappearance of the large endothelioid cells in this process. The swollen reticulum and endothelioid cells of the leukemic hyperplasias as illustrated by Cases IV and V are not reduced, but made more visible, possibly by increase in number. The anatomy of the lymphocytes in these two cases was not appreciably altered by *x*-ray but their number was reduced. In the lesions suggesting sarcoma as in Cases VI and VII where endothelioid cells do not appear prominently in the original picture they do not become more visible with *x*-ray treatment. The principal cells of these tumor-like cases are greatly changed under *x*-ray both in arrangement and individual character. Fibrosis in the lymphogranulomatous varieties is much more voluminous than in the leukemic and neoplastic. Fibrosis does not seem to increase between the cells after treatment when it has not been present in this location before radiation. The statement made by other writers and repeated in an earlier paragraph that normal architecture does not return in an abnormal lymph node under the action of roentgen rays is fully confirmed by the descriptions and photographs."

Warren, S. L., and Whipple, G. H. Roentgen-ray intoxication. *J. Am. M. Ass.*, Nov., 1923, lxxxi, 1673.

CONCLUSIONS

"Evidence from animal experiments and scattered clinical observations is convincing that the human intestinal mucosa is peculiarly sensitive to the hard and short wave-length roentgen rays. A similar condition certainly obtains in the common laboratory mammals.

"It is probable that the intestinal epithelium is at least as sensitive as the skin epithelium, and it may be more sensitive when we consider its increased distance from the roentgen-ray target and the intervening body tissues.

"Erythema doses or larger doses given over the abdomen or the intestinal areas may cause injury to this sensitive intestinal epithelium. Particular care should be taken when 'cross fire' is used over areas that include intestinal coils, as the loops may be seriously injured.

"Local roentgen-ray injury to intestinal coils may not give rise to severe clinical intoxication, but may cause ulcers that are no less chronic and dangerous than are the familiar roentgen-ray skin 'burns.'

"It is very desirable that all cases in which erythema or larger doses are given over the abdomen be very carefully studied and reported so that our knowledge as to the danger limits may be comprehensive. Until such time, we must use the data obtained from controlled animal experiments. Such experiments indicate that the intestinal epithelium is quite sensitive to hard irradiation. These facts should receive careful consideration by the radiologist who contemplates radiotherapy of abdominal areas (for example, pelvic tumors)."

HOERNICKE, C. B. Roentgen treatment of tuberculosis of the bones and joints. *Munchen. med. Wchnschr.*, July 20, 1923, lxx, 943.

Iselin proposed maximal radiation for tuberculosis of the bones and joints. Later he used less than the erythema dose, for fear of ulceration. Generally one-third of the skin erythema dose is employed, that is a dose, which, after one week's application causes slight reddening of the radiated skin, and brown discoloration after four weeks' application. Where abscess or fistula has formed smaller doses must be given. Some fibrous forms will remain uninfluenced. They must be treated with up to 60 per cent of the cutaneous erythema dose, at the focus. Within six weeks the skin gets, at most, one skin erythema dose. After three treatments an intermission of three months should be made. The screens used are either aluminum, copper, or zinc, according to depth of focus and type of skin.

Orthopedic and general treatment should be carried on simultaneously, especially where other tuberculous foci exist in the body. Splints which are used on the lower extremities should be changed every six weeks, and the radiation made at that time.

Tuberculin sensibilization of the focus may be of good effect, because it causes hyperemia. Surgery cannot entirely be replaced by roentgen rays, as had been hoped.

The customary doses have no influence upon the healthy bone and cartilage, while tuberculous granulations are hypersensitive to roentgen rays. If granulations surround a bony part, they will sequester it. A cavity with sharp borders will remain, which is filled in very slowly by bony tissue.

BUCKY and KRETSCHME. Roentgen rays for the improvement of the general conditions of feeble children. *Klin.-therap. Wchnschr.*, Aug. 6, 1923, ii, 1498.

While treating children for bronchial and pulmonary tuberculosis, with roentgen ray, the author noticed that the general state of health of the children greatly improved, after the first radiations. Not only did fever, cough and night sweats decrease, but fatigue and lassitude, for which some children were brought to the author, also disappeared, and the children seemed brighter, developed a better appetite. In two or three weeks they would gain 2 to 4 kg. The results were the same during convalescence from influenza, or other infectious diseases, and for overexertion in school, neuropathies and under-nourishment.

For these treatments one-half cutaneous erythema doses were applied over the sternum. When the effect wore off, after four to six weeks, treatment was renewed.

In 50 children the results were very satisfactory. In children with secondary anemia the hemoglobin increased, after two to three days, and was marked after two weeks. The increase in erythrocytes, though it existed, was not so marked.

MUELLER, WALTHER. Influence of roentgen rays on the bones. *Munchen. med. Wchnschr.*, July 27, 1923, lxx, 980.

The conclusion is reached that bony tissue, once formed, will undergo practically no change, even upon intense radiation. Cartilage has been found rather sensitive to roentgen rays. It still is true that a growth-promoting roentgen-ray effect in normal tissue, and more especially in growing bony tissue, is theoretically possible. But practically it has, so far, not been demonstrated. Roentgen rays, beyond doubt, arrest the growth of a fracture callus, when given in large doses.

NAKAHARA, WARO. Studies in *x*-ray effects. *J. Exper. Med.*, Sept., 1923, xxxviii, 309–314.

The curative effect of roentgen rays on cancer cells depends on the reaction induced in surrounding normal tissue.

Cancer grafts will rarely grow when inoculated into tissues which have received an erythema dose of roentgen ray, while grafts from some tumors will grow actively in the unradiated parts on the same animal. Sixteen mice were roentgen-rayed through an opening in a lead plate 15 × 20 mm. The dose was as follows: 3 in. spark-gap, 10 ma., 6 in. distance, 2½ min. Seven days later they were inoculated with cancer grafts (Bashford adenocarcinoma No. 63) in the roentgen-rayed and in the protected regions. Six were killed, a pair at a time, forty-eight hours, four days, and seven days after cancer inoculation. The cancer grafts, with the surrounding tissue on both sides, were removed and fixed in Conroy's chloroform-alcohol-acetic fluid.

The other ten were killed in pairs, twenty-four hours, forty-eight hours, three days, five days, and seven days after cancer inoculation. The grafts were removed and fixed in formaldehyde.

Six controls were subjected to the same roentgen-ray treatment and inoculations, but not killed; in three weeks five out of six inoculations in the protected area resulted in vigorous tumors and only one tumor in six inoculations in the roentgen-rayed area.

SUMMARY

Cancer cells implanted in a skin area previously exposed to an erythema dose of roentgen-ray show a series of degeneration changes comparable in every way to those described in cancer-cell degenerations following roentgen-ray treatment. This contrasts strongly with the survival and growth of grafts implanted in unexposed areas in the same animal. The result is the same whether the cells are exposed directly in situ or merely implanted in the previously exposed skin.

Ochsner, A. J. Cancer from the surgical standpoint. *Radiol.*, Sept., 1923, i, 1.

After referring to the history of surgery of cancer the author refers to the use of the red-hot soldering iron as an operating instrument and then to the electric cautery and says that in all of these cases the patients have had after-treatment with roentgen ray, so that we cannot be certain about the part each of the two methods had in preventing recurrence.

He considers it best to place the entire radiologic treatment in the hands of an expert radiologist.

He feels certain that a number of lives have been saved by wide excision, preferably by means of the actual cautery, and that many of his patients are alive today who would have died had they been treated with radium and roentgen ray, either combined or singly.

He feels that all cases of malignant growth should be treated with roentgen ray before operating; that this kills the cancer cells which have progressed beyond the field of operation, produces immunizing substances, and prevents grafting of cancer cells with the knife as it passes through some lymph gland or space beyond the tumor proper.

He is not certain whether it is best to operate immediately after the patient has recovered from the depressing effect of deep roentgen-ray therapy or to wait several days or weeks. At present he operates within a week after the recovery.

In many cases he gave several courses of roentgen-ray treatment at intervals of from six to sixteen weeks following the operation. A number of these cases are alive after from five to sixteen years.

Since using a more powerful machine they usually give one prolonged treatment following the operation.

In some cases it has seemed that patients who received one prolonged intensive treatment before the operation and none afterward were more likely to remain free from recurrence than those who were treated before and after.

He refers to three blunders that were committed which resulted in the death of the patient: (1) Waiting to make certain of the diagnosis of cancer. By this time metastatic infection had occurred and the case was hopeless. (2) Scrapings or sections of the suspicious tissue were examined microscopically. At that time these specimens were removed with the knife or the curette. These patients died regularly from metastases. Not a single case in which the scrapings or the piece excised with the knife showed the presence of cancer has escaped death as a result of metastatic infection. (3) The tumor was removed with a knife. These patients had local recurrence and later metastases, but they all died.

Among his conclusions are: remove a malignant growth at the primary operation as widely as you would expect to remove it after the first recurrence; use the actual cautery whenever it can be used; always work in conjunction with a competent radiologist.

Sielmann, Hans. Influence of roentgen rays on the sodium chloride metabolism and its relations to the therapy of "Roentgenkater." *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 87.

Experimentally, it has been shown on dogs with vesicular fistula that the urine is increased and that potassium chlorid is eliminated to a higher degree after roentgen treatment. Parts of the skin and the liver were examined for their potassium chlorid content. It was found reduced up to 33 per cent. In the Institute Holzknecht 200 patients were treated with salt, and it seems that the bad effects of roentgen treatment were greatly reduced by it.

It must be mentioned, however, that the change in the salt metabolism is not the only cause for the malaise following radiation. It seems that the entire mineral metabolism is put out of balance, and that probably the albumin is also influenced. A firm in Vienna (Chemosanwerke) has prepared gelatin capsules with 1 gm. pulverized sodium chloride, adding a small amount of menthol-Valerian, and also glass vials with a 10 per cent. sodium chlorid solution called roentgenosan. These have been used with good effect in the above-named roentgen institute.

Cotte, G., and Michon, L. Epithelioma of the uterine cervix of the type of perithelioma. *Bull. Soc. d'obst. et de gynéc.*, May, 1923, xii, 305.

There is presented a study of histological sections taken from a tumor of the neck of the uterus, the mass extending out of the neck into the vagina. At first view and under low magnification one saw in a uniform field stained with eosin rounded or elongated masses strongly colored with hematin and all centered on a vessel. The preparation recalled those tumors elsewhere described under the name of perithelioma. The axis of the neoplastic nodule is formed by one or several vessels with capillary structure and sheathed in a sleeve of neoplastic round cells with a large nucleus. These nodules are scattered in a mass of necrobiotic tissue in the middle of which one can recognize no element. It is evidently an epithelioma, but the neoplastic cells are localized in the length of the vascular sheaths, whence the peritheliomatous aspect. Such tumors are rare, above all at the level of the neck of the uterus.

The authors found them described only in the book of James Ewing on "Neoplastic Diseases," who says that in certain atypical epitheliomas of the neck, with rapid growth, the cells arrange themselves around the vessels giving a peritheliomatous structure.

After removing a specimen for histological examination two tubes of 30 mg. each of bromide of radium were placed in the uterine neck from August 8 to August 10. The patient refused a second application of the radium on account of the pain induced by the first application, but the tumor disappeared clinically in less than eight months. This tumor was peculiarly sensitive to the action of radium. A dose of 25 mc. sufficing in place of the usual 50 mc.

Pritchard, J. S. Some interesting cases of calcareous degeneration found in the thorax. *Arch. Int. Med.*, Aug., 1923, xxxii, 259–282.

After an exhaustive historical summary of clinical observations and experimental work on this subject the author gives the following summary of the etiological factors in calcareous degeneration.

1. Any irritant to the tissues, either mechanical, chemical or infectious, the latter being a most important factor in the cases presented in this article.
2. Any condition which lowers the vitality of the organism.
3. Changes in the composition, velocity or volume of the blood.
4. Interference with the general or local nutrition.
5. The questionable effect of blood and tissue chemistry.
6. Poor assimilation or deficient metabolism of the involved tissues.
7. Constitutional conditions affecting the general metabolism.
8. Any disease of the osseous system which may cause the liberation of lime salts.
9. Alterations in the tissues which cause retention of chronic irritants, such as necrosis, suppurations, chronic inflammatory changes or traumatism.
10. Special selective power of certain tissues for lime salts.
11. The effect of sunlight on the body tissues and metabolism. The production of rickets in mice through deficient supply of actinic rays suggests the presence of a definite influence of sunlight on the process of calcification.
12. Vasomotor disturbances.
13. Possible influences of endocrine derangements.
14. Variations in the carbon dioxide blood content.
15. Hemorrhage into the tissues.
16. Factors influencing osmosis.
17. After all theories have been propounded, there still remain a goodly number of cases of calcareous degeneration unexplained from the etiologic standpoint.

Calcareous degenerations may occur in almost any tissue of the body, the peritoneum being perhaps the least frequently affected.

There was made at Battle Creek Sanitarium Clinic a routine procedure in 7,000 cases as follows: at the time of the physical examination of the chest a careful history was taken; the laboratory finding included a Wassermann test. In each case stereoscopic chest plates were secured which were interpreted by the writer in conjunction with the clinical study. The final opinion was based on a summary of the whole investigation. Nevertheless it is with considerable hesitancy that any opinion is offered. A few points present themselves which may be of importance: 1. The number of cases with frank lesions in the upper portions of the lungs, active or inactive, which showed no definite sign of calcification in the thoracic cage is remarkable. 2. Extensive calcification of the ribs or cartilages occurs frequently without any pulmonary disease. 3. The long, thin, flat, narrow thorax may be more prone to calcification of the upper anterior part but in the author's series he has found a considerable number of calcified deposits in all forms and types of the adult thorax.

Calcification of the pleura is not uncommon. Empyema is the most common cause, when the deposits take the form of plaques or platelets. The clinical history suggests that most of the pleural calcifications are probably not due to the action of the tubercle bacillus.

The diagnosis of calcium deposit was seldom made prior to autopsy before the advent of the roentgen ray. The dense, hard, concrete, clean-cut shadow in the roentgenogram is characteristic.

Concretions in the lungs produce no symptoms unless they cause erosion of the bronchi or lung tissue, in which case they act as a foreign body.

Fifteen case reports are given, illustrated by roentgenograms.

Pancoast, Henry K. Roentgenologic studies of pneumoconiosis and other fibrosing conditions of the lung. *Ann. Clin. Med.*, 1923, ii, 8–23.

There are three definite sets of shadows in the normal lungs due to the hilum, to the trunk shadows and to the finer linear markings. The conglomerate shadow of the hilum is distinctly visible on each side of the denser shadow of the heart and great vessels and is cast by the bronchial walls, vessels, connective tissue, lymph-nodes and all non-air containing structures at the root of the lung. The trunk shadows fade into the finer disappearing linear markings.

These shadows may be accentuated, or areas of structureless lung be made visible by active or passive congestion or fibrosis. The appearance is frequently not characteristic of the disease, when history and other clinical data aid materially in forming a correct interpretation.

The roentgen study must be regarded as a single method of examination in addition to the clinical procedure and a correlation of the combined data is essential in reaching a correct diagnosis. Roentgenoscopic observation is important in study of fibrosis of the lung. Fibrosis limits the movements of the diaphragm because of the resulting lessened elasticity of the lung and through the additional involvement of the pleura and even the diaphragm.

The two most frequent causes of fibrosis of the lung are tuberculosis and pneumoconiosis. In each the active agent is airborne and gains access to the pulmonary lymphatic system from the air passages beyond the range of the ciliated epithelium. It is usually possible to determine the presence of pneumoconiosis even when both conditions are present, and where doubt exists a proper correlation of the roentgen and clinical data will practically settle the question. There may be clinical points of resemblance between the two conditions and positive sputum or repeated negative findings will be the deciding clinical factor. The two conditions frequently exist in the same individual. Pneumoconiosis apparently protects from tuberculosis, though more complete statistics may dispel this impression.

Inspiration of dust is not itself harmful. The quantity is not so important as the quality, the important injurious constituent being silica. The dust in potteries does not produce pneumoconiosis in the absence of silica. Pneumoconiosis is found among farmers in sandy soils and among those who live where sand storms are prevalent. Miners who work in the harder rocks with large silica content show much more marked changes in the lung than those of the coal mines.

A knowledge of the histology of the pulmonary lymphatic system and of the lymphatic drainage of the lung simplifies the understanding of the roentgen appearances of the lung.

There are three stages of progress from the roentgen standpoint: 1. Peribronchial and root thickening; 2. localized parenchymal fibrosis; and 3. diffuse fibrosis.

The increased extent and density of the hilum shadows and the increased prominence and thickness of the radiating trunk shadows found in the first stage is by no means characteristic of the condition. The same appearance may result from any respiratory infection or irritation, congestion, or infiltrating metastatic carcinoma. Any dust not containing silica may cause it, but such dusts do not produce the subsequent stages of pneumoconiosis. Silica probably gains entrance to the lymphatic system mostly beyond the ciliated epithelium. Some of it is deposited in the adjacent lymphoid deposits, but much is carried onward by the lymph vessels and deposited in the lymph glands at the root of the lung where it acts as an irritant and produces fibrosis.

The characteristic diffuse fibrosis of the second stage is always very striking and is at once recognized as pneumoconiosis. The distribution is characteristic as well as the appearance. There is nothing with which it can be confused except possibly the appearance in some cases of miliary tuberculosis.

The third stage is that of diffuse fibrosis. The appearance is more or less symmetrical and resembles the end result of no other condition but that of symmetrical diffuse tuberculosis.

The transition from the second to the third stage seems to take place most frequently as an apparent conglomeration of the mottling into larger areas resembling consolidations, usually with the densest areas in the subapical regions.

The lymph drainage of the lower lobes differs from the other portions passing to and through the ligamentum pulmonale and not to the hilum. The fibrosis may displace the heart and great vessels, restrict costal expansion and limit diaphragmatic movement. Emphysema is a constant result and bronchiectasis frequently occurs.

Clopton, Malvern B. Eventration of the diaphragm. *Ann. Surg.*, 1923, lxviii, 154–163.

This article presents two cases of eventration of the diaphragm that offered interesting problems in diagnosis, leading in one case to an unnecessary operation.

There is a high-lying diaphragm on the left side, with the stomach, spleen, and large bowel occupying the space usually filled by the lung. The heart is in the right chest. The stomach is large. The large bowel is also dilated and enlarged; the liver vertical and right sided. The chest wall shows a slight bulging of the lower half of the left side. This condition was designated by Cruveilhier as eventration of the diaphragm. It occurs nearly always on the left side. The chief confusion in diagnosis will be with diaphragmatic hernia. In roentgenoscopic examination, the diaphragm moves with respiration. In diaphragmatic hernia, a "paradoxical expiratory displacement" has been noted—with forced inspiration the herniated diaphragm ascends, and with expiration it descends.

Eventration has been operated on because of a diagnosis mistaking it for pyopneumothorax, as in our first case, and as in a case reported by McNab.

Eliot, Ellsworth, Jr. Certain features of renal calculus. *Ann. Surg.*, 1923, lxviii, 231–238.

Urine collected by ureteral catheterization from either kidney does not always show the same composition and may vary to such an extent as to actually differ in reaction.

The subjective symptoms, while of relatively small diagnostic value, are of importance in leading to roentgen examination and for that reason deserve study and consideration. Pain, unquestionably the most constant symptom, is subject to frequent variation. In place of the typical lumbar pain radiating downward and forward along the course of the ilio-inguinal nerve, this symptom may be more or less localized and even referred anteriorly to a point above or below the level of the umbilicus. This is of importance in the differential diagnosis of renal calculus from inflammatory conditions of the gall-bladder, duodenum and pancreas, and strongly emphasizes the need of roentgen examination.

Renal calculus may be without symptoms. The writer believes that this is much less frequent than in gall-stones.

The roentgen ray has proved of the greatest value in determining the number of calculi and their approximate positions. This information ordinarily directs the point of attack, and defines the limit of operation so that unnecessary exploration is avoided.

The need for careful investigation of the chemistry of the urine of the affected kidney, both before and after operation, and comparison of this to the normal kidney is great. Future progress in the treatment of this condition surely lies in the development of the knowledge of those changes of tissue metabolism which predispose to their formation and to the discovery and adoption of suitable measures to regulate and maintain normal metabolic changes in the tissue cell.

Williams, John G. X-ray treatment of lesions of the thyroid gland. *Long Island M. J.*, 1923, xvii, 353–359.

Plummer has shown that the intravenous administration of 10 mgm. of thyroxin to a patient with myxedema elevates the basal metabolic rate 28 points. The maximum elevation is reached from five to ten days and does not return to the previous rate until thirty or forty days later. Clinically, he determined that 6 mgm. daily is the average requirement of an ordinary case.

Cannon and Smith have shown that stimulation of the cervical sympathetic causes increased secretion of the thyroid. He classes goiter as simple, cystic, colloidal, adenoma, exophthalmic, and malignant. Of these, the adenomata with hyperthyroid symptoms, the exophthalmics, and the malignant cases are suitable for roentgen therapy. Usually, a basal metabolic rate in excess of plus 15 is found in hyperthyroidism.

Toxic adenoma responds readily to the roentgen ray but surgery is quicker and the mortality in these cases is low. The technique has been to treat the thyroid and thymus areas on each side separately with four mm. of aluminum as a filter, a nine-inch spark-gap, at a distance of nine in., for six minutes to each area. Latterly, where the tonsils showed marked hypertrophy, he has included them in the area to be treated, extending the distance to twelve in. and time to nine and one half minutes. The second treatment is given three weeks later, and a third treatment four weeks after the second, the interval between treatments being extended one week longer than each preceding interval. Usually, at the third visit, seven weeks after the first treatment, there is noted a slowing of the pulse rate and an amelioration of the nervous symptoms. After this, the patient begins to regain some of the previous loss in weight. The eye symptoms and the goiter are the last to show improvement, and frequently do not wholly disappear.

Among his conclusions, he says that patients treated surgically do better and the risk of operation is less if they had previously had their thymus glands irradiated.

Grashey, R. Rare roentgen findings. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 59.

At the Congress several rare pictures were shown; first, pericardial calcification as large as a twenty-five cent piece in the apex of the heart of a woman fifty-six years old, with hepatic enlargement and swelling of the lower extremities.

Second, calcification of the pleura in a man, fifty-three years old, who had suffered thirty-three years previously of pneumonia. He had had emphysema and bronchitis. A dense, arched, notched shadow was seen which passed below the ribs when the patient turned. A roentgenogram of the post mortem section showed calcification of the pleura. In a woman, forty-one years old, there was a long, dense, notched shadow which ascended vertically, and crossed the shadow of the vessel; parallel with it was a brooch-shaped shadow; the diaphragm was adherent. A man fifty-five years old, showed a shadow on the left side in front and above, starting at the apex. It was dense and sickle-shaped, bent like the ribs, but not quite as much. Granular structure was seen at the lower portion. He had been stabbed twenty-five years previously in the upper part of the thorax. Probably this was the old canal where the dagger had penetrated.

Third, extensive ossification of the tendon of Achilles; the arteries were hardened. Man seventy-four years old.

Fourth, egg-shaped calcification in the right kidney containing carcinoma.

Fifth, forked ribs. One was the left third rib, and in another case the first rib on both sides.

Sixth, a case of Koehler's metatarsal disease in a girl sixteen years old who had been treated for spina ventosa of the first and fourth fingers. When a child, she had suffered glandular swelling and inflammation of the eyes. For two years she had had pain in the head of the second tarsal. No traumatism could be remembered.

Seventh, myeloma in a man seventy years old, who had complained of pain for six months in the entire thorax. He was emaciated and pale. Albumin bodies (Bence-Jones) were found in the urine; in the blood 18,000 white blood corpuscles, of which 80 per cent. were plasma cells. Later they increased to 80,000. The roentgenogram showed spotted light areas in the ribs, with a healed spontaneous fracture.

Strauss, O. The influence of roentgen rays on endocellular and metabolistic processes. *Fortschr. a.b. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 80.

It has been shown, experimentally, that roentgen rays cause: First, a decrease in the cholesterin content of the blood; second, increase of osmotic pressure in the blood; third, the decrease of surface tension; fourth, the increase of hydrogen ion concentration; fifth, changes in the mineral metabolism.

This causes an effect upon the lipoid mixture which explains part of the roentgen-ray effect on the cell.

Groedel, Franz. Heart motion in the roentgen kinematogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 42.

Roentgen moving pictures serve the purpose of showing the motion of the internal organs and making deductions from them. Two to four pictures a second will be sufficient, but for some of the more rapid proceedings, especially those which occur in the heart, a correct speed at ten to sixteen pictures a second must be made.

The pictures which Groedel showed at the meeting of the Congress demonstrated three different stages of the heart action: First, the pumping, where the right and left borders of the heart, for a short time at least, showed a contrasting position which alternated. Second, the pendulum movement, which, for a longer period, will show the left border of the shadow in a contrasting position, while the right is dilated and vice versa. Third, peristaltic action was seen on both borders, appearing as a progressive contraction of the border of the shadow from above downward.

For scientific purposes the pictures must be supplemented by electrocardiographic curves. On these curves the single phases must be marked. The author combined the two in a kinematogram on a "trick film."

Altmann, V., Rochlin, D., and Gleichgewicht, E. The effect of roentgen rays upon growth acceleration and retardation. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July 5, 1923, xxxi, 51.

To study provocative doses of roentgen-rays the authors at first used plants. These investigations, however, did not give any definite basis for the influence upon pathological conditions. It was found that the irritation produced a temporary acceleration of development and an influence upon the vitality of the tissues, which seemed even to have a detrimental effect upon them. The question is asked which pathological processes would be amenable to this therapy. The authors say, hardly tuberculosis, for it is not proven that this irritation will have a lasting beneficial influence upon the defensive tissues. The dosage cannot be definitely determined. The effect will be similar in all other processes where a provocation of growth of an existing or forming normal or pathological tissue is expected.

The results of these experiments are somewhat comforting in the line of carcinoma therapy. The danger from lower grade rays seems at least exaggerated.

Wimberger, Hans. Roentgen symptomatology of the infantile mediastinum. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July, 1923, xxxi, 33.

It seems that air accumulates more frequently in the infantile mediastinum than in that of the adult. It may enter through the throat or the lungs. In the first instance, expiration is impaired, and in laryngeal diphtheria, with or without tracheotomy, and in pertussis it has often been observed. If starting from the lung, interstitial emphysema is the cause, a disease which is characteristic of childhood. It will occur in laryngeal croup, pertussis, pneumonia, tuberculosis and will either pass between the lobular sections beyond the pleura, or along the peribronchial tissues, across the base of the lung to the mediastinum, where high grade distention may ensue. It may pass into the pericardium and upward in the subcutaneous tissue of the neck.

Dupuytren, as early as 1837, diagnosed mediastinal emphysema in an infant ten months old. Clinically, a small vesicular rubbing sound, which is synchronous with the heart action, will be heard sometimes over the entire extent of the sternum, extending toward the right to the parasternal line, and to the left as far as the mammillary line. Cardiac dulness will disappear partly or entirely, and instead, a sonorous percussion sound will be audible. In some cases cardiac dulness is unimpaired. The displacement of the lung and heart may cause involvement of the heart and circulation.

No roentgenologic diagnostic signs of this disease in the child have been described excepting by Assmann, who finds light bands along the borders of the central shadow, or light spots within the shadows of the soft parts. Bergmann describes the findings in an adult where a light triangle was seen over the diaphragm, it was paravertebral. He considered the case one of mediastinal pneumothorax. One might also think of paramediastinal genuine pneumothorax.

Child, two months old, badly nourished, suffering from kerato-malacia. Purulent discharge from the eyes, which disappeared upon giving cod-liver oil. Five weeks later dyspnea with short inspiration and labored expiration, no cough, auscultation of the lungs negative. Another three weeks later bulging of the upper sternal region. On the left side in the back above great dulness, without distinct bronchial respiration. Patient died after having been ill seven weeks.

The roentgenogram showed very large distended thorax, ribs in position of inspiration, which is almost entirely diaphragmatic. The very light lateral part of the right pulmonary area, in its center, merges into a fine striated shadow, with a medial paravertebral narrow, light zone. The heart is displaced into the left pulmonary area so that only an opaque phrenicocostal angle and an abnormally light upper third of the lung is visible. The retrosternal space is very large and light, the heart displaced backward and downward. Roentgenological diagnosis lay between pneumothorax and mediastinal emphysema. The latter was taken as more probable on account of the abnormal air contents in the spotty diffuse mediastinal channel. The roentgenogram changed when the patient died so that the heart was then not as far displaced toward the left. Post mortem revealed interstitial emphysema of the right lung, with many vesicles on the mediastinal side. Confluent lobular pneumonic foci were seen in both lower lobes and at the base of both upper lobes.

Another case of pneumomediastinum in a child seventeen months old is described.

Leusden, P. Roentgen ulcers, and their surgical treatment. *Med. Klin.*, Sept. 2, 1923, xix, 1181.

Not all patients who have roentgen ulcers have been rayed by physicians inexperienced, or not sufficiently familiar with roentgen-ray methods. Quite a number have been in the hands of successful roentgenologists. Many members of the profession must work with old apparatus, not altogether up to date. But even those who have all the refinements of the method do not escape suits for malpractice in this field. After all not all problems involved in roentgen rays have been definitely solved, and the difference in toleration in each individual, the appropriate focal distance, dose, and screening cannot always be estimated with mathematical accuracy. Treatment tolerated by scores of patients will suddenly, in another individual, produce harm. The difference in individual tolerance is estimated at 15 to 20 per cent. Discrimination has greatly improved, and not all cases are treated by the roentgen ray which was the case, for a period, not long past. Operation is deemed necessary, in more instances, even by enthusiastic roentgenologists, who, not long ago, denied the necessity of surgery.

Generally the cases coming to the author are subacute or chronic, and all suffered intense pain. In one case angioneurosis developed. The pain, the author thinks, is caused by the baring of nerve ends in the wound, which are not covered by granulation. The toxic necrotic surrounding tissue keeps up an irritation. To allay this pain "Zykloformvaseline" (10 per cent) has been most effective.

The ulcer is most painful, has well defined borders, and a necrotic yellow base, with red and blue groups of vessels.

The best treatment is to cut out the ulcer like a malignant neoformation, reaching into healthy tissue. Bridge flaps or pedunculated flaps are desirable, containing a larger artery for nutrition. It is not advisable to take flaps the ends of which extend across the median line. The flaps must be one and one-half times as large as the defect. Epithelial pulp is used in the after-treatment of the flap defect. Where thickening at a site which has been roentgen-rayed, arouses the suspicion that a roentgen ulcer is forming, it is well to make a prophylactic excision.

Teschendorf, W. Representation of the gall-bladder in the roentgen picture by means of distention of the duodenum and jejunum. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* 1923, xxxi, Kongressheft, 54.

The distention of the transverse colon from the rectum had been suggested for demonstrating the gall-bladder on the screen. Henszelmann made the projection from behind and above downward into the front along the slant of the lower surface of the liver. The patient was rotated to the second diagonal diameter. This method was not always successful. Even the pneumoperitoneum did not always assist. The author introduced air into the duodenum by means of the duodenal tube. On an empty stomach the duodenal tube is introduced through the nose. If the tube does not pass the pylorus easily a small quantity of milk can be given because the head of the tube willl penetrate more easily when the casein is passing the barrier. When the duodenal fluid is flowing freely the tube is pushed down farther, for without this much air is retained in the stomach. In order to close the pylorus, thick barium meal is given, then sufficient air is introduced to cause a sensation of pressure. Air will reach the first jejunal loop from the duodenum readily. Much air can be introduced in this manner. If it should be retained in the stomach, the patient is directed to dispel it by eructation. The plate is made in the position described by Henszelmann, but not in the oblique position.

The author admits that practice is necessary for perfection in this method.

Kuepferle. Anatomical analysis of the roentgen picture in pulmonary phthisis. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* 1923, xxxi, Kongressheft, 14.

The author studied the roentgen pictures of patients with pulmonary phthisis, and sections made, post mortem, after injections of formalin. Comparing these, he had better results than with the post mortem roentgenograms. In roentgenograms, lobular exudative formation of foci resemble bronchopneumonia foci. Blurred, spotty shadows are produced. When large areas of the lung are involved, these shadows will become confluent. The anatomical focal reaction will produce secondary changes of induration and scar formation on one hand, and caseation and degeneration on the other. They are all well demonstrated in the roentgenogram. The two latter conditions will produce dense shadows. The resulting shrinkage and distortion between the indurated foci will show as light spots between the dense shadows. Fibrinous changes will often show up as irregular branching, striated shadow formations. The recognition of cavities in the roentgenogram is dependent somewhat upon the changes of their walls. Often focal changes outside of the cavity will project shadows into them. Indurations, in their walls or surroundings, will often show up in the shape of rings or bands grouped about the lumen. Cavities generally form in the back and upper sections of the lung. They extend forward and downward. Their recognition is rather difficult. Bronchial involvement will show an arrangement of foci in groups in the various pulmonary areas on the roentgenogram. If the foci are disseminated the pathological process may be considered hematogenous.

Pordes, F. On the nature and effect of roentgen rays, especially on the disappearance of anuria on radiation of the kidney. Zentral-Roentgeninstitut, Allgemaines Krankenhaus, Vienna (Prof. Holzknecht.) *Wien. klin. Wchnschr.,* Sept. 13, 1923, xxxvi, 656.

A two hours' debate ensued at the Roentgen Congress, when Holzknecht and Pordes expressed the opinion that the action of roentgen rays, in anuria, was not stimulation, but a relief of pressure in the infiltrated renal tissue. They argued that decapsulation of the kidney in anuria would reestablish its function. Anuria is caused by a condition of over-pressure, produced by inflammatory products, especially by leucocyte infiltration. Leucocytes are very sensitive to roentgen rays, and are quickly destroyed by them. Radiation will relieve tension from infiltration, and will reestablish the renal function. This explanation would serve even if one would consider anuria a consequence of angiospasm, as does Volhard. The spasm would be eased.

This theory contradicts the Arndt-Schulz theory, according to which it is postulated that all agents stimulate all cells, when given in small doses, that they will paralyze in medium doses, and kill in large doses. This theory was very generally applied in its simplicity to roentgen action during the last few years.

Ritter, Hans, and Moje, Otto. Experimental examinations on the effect of roentgen rays on tubercle bacilli and tuberculous tissue. *Strahlentherapie*, 1923, xv, 283.

It is well known that a number of tuberculous processes are reduced by the roentgen ray in a manner that would almost amount to a cure, for instance in tuberculous lymphoma of the neck. The glands will atrophy so far that for the rest of the life of the patient one may not be able to feel them. The nature of the effect, however, is not known so far. The effect is not a direct destruction of the tubercle bacillus. The process must be an indirect one. Backmeister says that the proliferating tissue is converted into scar tissue in the sense of nature's healing. The granular tuberculous tissue is destroyed. Rollier is of the opinion that the rays act as bacterioides, oxidizing, reducing, sclerosing, and modifying.

The authors tried a number of experiments on guinea-pigs which had been infected with tuberculosis. They were treated with roentgen ray in different doses, and at different times of the infection. At certain intervals the glands were cut out and examined for tubercle bacilli. The material of the excised glands was inoculated into healthy guinea-pigs in order to study the virulence of the bacilli. Radiation of the inoculated portion immediately after inoculation did not cause any change in the course of the tuberculous process with varying doses. This would show that the effect is not direct upon tubercle bacilli. Neither small nor large doses can effect the local resistive power of the body in the surrounding tissue.

Three animals were radiated with full doses of unfiltrated ray. The tubercle bacilli were neither killed, nor was their virulence diminished. The only feature which was of note was the extensive connective tissue proliferation, and the scar tissue formation.

A 10 X radiation with rays filtered through a 2-mm. aluminum screen was applied to tuberculous glands directly. One month later the glands were found caseous, containing abundant tubercle bacilli and pus. Evidently, the bacilli were not killed, and their virulence not diminished.

The authors arrive at the conclusion that roentgen rays alone cannot heal tuberculosis. Even if tuberculous lymphoma is caused to shrink, the patient must be regarded as a tubercle bacillus carrier. Disson has correctly intimated that one could not always decide whether a new infection had occurred, or whether the process of shrinkage had been reduced. The tubercle bacilli are enclosed in firm scar tissue, and must remain there so they may do no damage.

Schwarz, Egbert. On injuries sustained during roentgen treatment of myomata and hemorrhagic metropathies. *Strahlentherapie*, 1923, xv, part 3, 398.

Roentgen treatment has been resorted to more and more during the last decades in benign diseases of the female genitals, especially in myoma. The technique of treatment is not as definitely agreed upon as is the indication. The various methods which had been employed since 1914 are that of Albers-Schönberg, which gave small doses in a series of radiations; the Freiburg technique which employed large doses in series; some authors then used medium, and others excessive doses in series. Recently, Freiburg has adopted a new technique, radiating once, 50 to 70 X surface dose equals 20 to 30 X deep dose. It is characterized by the application of the full castration dose in one session. Myoma and metropathies treated with this new technique have yielded 90.5 per cent cures, 0.15 per cent recurrences, 4.9 per cent improvement, and negative results in only 2.7 per cent of cases. When considered separately, myoma 90.5 per cent were cured, and metropathies 99.4 per cent. The complications consist mainly in slight erythema, while bladder and intestines are not irritated. Another group of reports gives nausea, vomiting, diarrhea, and roentgen malaise.

The author's experiences with carcinoma radiation have shown that the intestine will tolerate relatively high doses of 100 to 120 per cent. The Wintz numbers of 130 to 135 per cent are evidently the highest deep doses possible, but there are certain individuals who do not tolerate them, and who will develop hyperemia with comparatively low radiant energy.

The heavy filter in roentgen therapy has been very beneficial, although some sequellae have been disagreeable.

In using the Freiburg recent method, the author has found, in his material of women between forty-one and fifty-nine, excepting three, who were younger, that hemorrhage became more profuse in 11 instances, but 25 women definitely became amenorrheic, and remained so. No recurrence was seen in from one-half to two years. Only one woman was not rendered amenorrheic.

Even during the time of radiation, but more frequently later, vomiting was seen in 12 cases; furthermore, dizziness, headache, and diarrhea in 10 women, that is, 38.4 per cent. The complications were considerable in the beginning. These disagreeable effects lasted up to two months, generally ten days to two weeks. Diarrhea, in some instances, was almost uncontrollable, and the patients became much weakened by it. Intestinal tenesmus was excessive. Much slime and blood in some instances. But soon the patients began to experience the beneficial effects. The symptoms of artificial amenorrhea were not very marked, excepting in 2 cases.

AMELUNG, WALTHER. Can arthritis urica be diagnosed definitely by *x*-ray? *Fortschr. a. d. Geb. d. Rontgenstrahlen*, July, 1923, xxxi, 44.

Anatomically, as well as clinically and roentgenologically, arthritis deformans and polyarthritis chronica show definite differences. The former is characterized in the roentgenogram by marked proliferation of the bone and cartilage, with numerous articular bodies. Generally, there is no ankylosis, and atrophy of the skeleton is slight. In chronic polyarthritis there is a thickening of the capsule and the peri-articular soft parts, followed by an early porotic bony atrophy with marked tendency to ankylosis. Proliferation is not marked. However, deforming processes may set in in the latter stages of chronic polyarthritis. It is then that diagnosis becomes difficult. Aside from these symptoms, there are definite disturbances in the joint in gout which is characterized by accumulation of uric acid in the tissues and in the blood. Koehler, Jacobsohn, Drinberg, Brugsch and Wollenberg have shown that by the roentgen ray you can show certain changes which will allow of the diagnosis of uric arthritic. The change consists in oval or round transparent spots, with a border which is sometimes well-marked. They range from a few millimeters to a centimeter, and may occur singly or multiply in the epiphyses, and in the diaphyses. At first, only pits as large as the head of a pin will be observed at the ends of the joints, and the borders of the bone. These may change to bony defects, either round or crescent, or may appear punched-out. These are all typical signs for gout, and useful in early diagnosis. Krebs, however, is of the opinion that the same signs are seen in all chronic articular conditions. When; however, compared with the clinical signs, the diagnosis may be arrived at.

The author, in a series of 7 cases, demonstrates, however, that similar roentgenograms will be seen in chronic polyarthritis, arthritis urica, and arthritis deformans.

LEWIS, THOMAS. Movements of the heart axis with respiration. *Heart*, 1923, x, 264–265.

SUMMARY AND CONCLUSIONS

1. In a patient in whom a rifle bullet had become fixed in the ventricle, observations have been undertaken upon the movements of this bullet during the heart beat and during respiration.

2. The bullet showed a pendulum-like swing with the heart beat, its base (the lower end) moving conspicuously towards the heart's apex in systole and receding from it in diastole.

3. During expiration the bullet moved almost vertically upward; at the same time it altered its obliquity to the vertical, the movement being anti-clockwise. This change in the bullet's obliquity has been measured and the change of angle compared with that occurring in the electrical axis of the heart. The two changes were found to be identical in the erect position of the patient, but showed a conspicuous divergence while the patient sat.

4. It is thought to be improbable that movement of the electrical axis of the electrocardiogram resulting from respiration necessarily gauges accurately the movement of the heart's anatomical axis.

CAMP, JOHN D. The normal and pathologic anatomy of the sella turcica as revealed at necropsy. *Radiol.*, 1923, i, 65–73.

The dimensions of the sella turcica in normal specimens were measured in the anteroposterior, vertical and transverse directions. The anteroposterior measurements were taken from the most dorsal point of the tuberculum sellae in the sagittal plane. This represents the true anteroposterior dimension of the outlet of the pituitary fossa. The vertical or depth measurement was taken along a line dropped from the anteroposterior line to the deepest point on the floor of the sella. The width represents the distance between the lateral boundaries of the fossa.

Gordon and Bell, in a roentgenographic study of the sella in normal children, classified the various shapes into three types: the circular, oval, and flat. The circular type was found in 70 of the cases studied by them, the oval in 25 and the flat in 10. These authors also conclude that there is no relation between the size of the head and the size of the sella, and that the shape of the sella has no significance except in the flat group, which is always found in small heads.

Applying the classification of Gordon and Bell to the series reported here, the oval type was found in 66 per cent, the round in 21 per cent, and the flat in 13 per cent of the specimens measured. The greatest anteroposterior dimension of the pituitary fossa was measured from the outlines in the sagittal plane along a line from the anterior wall to the farthest point on the posterior wall in the horizontal plane. The average distance of this dimension was 1.14 cm., the maximal distance 1.5 cm., and the minimal 0.8 cm. The average distance for this measurement will be somewhat more than that of the anteroposterior distance of the outlet of the fossa, due to the anterior curving of the dorsum sellae in the majority of specimens.

BAUMAN, GEORGE I. The relation of lesions of the transverse processes to pain in the back and legs. *J. Bone & Joint Surg.*, 1923, v, 579–589.

Routine roentgen examinations and dissections of the lower spine reveal wide variations in the length, shape and direction of the transverse processes. The nerve cords and parts of the lumbo-sacral plexus and some of their branches are in close proximity to and directly in front of the transverse processes of the lower four lumbar vertebrae. Any slight change in position of any of these processes due to fracture or rotation of the vertebral body can result in direct pressure on the plexus. The irritation of these nerves may be responsible for neurological symptoms in the distribution.

In cases indicating lesions of the lumbar transverse processes, the most constant finding and one of much significance is, "the location of a definite highest point of tenderness to deep pressure on the tip of one of the transverse processes. In a number of cases, the patient volunteered that he 'had pain down the leg' in addition to the local tenderness, when pressure was made directly over the site of the lesion."

The author presents the history of twenty cases.

The roentgen ray has been of valuable assistance in the identification of abnormalities and in certain cases of fractures. In several instances the roentgen diagnosis of fracture proved erroneous.

SHAW, WILLIAM FLETCHER. Carcinoma of the female urethra with notes of two cases treated with radium. *J. Obst. & Gynec. Brit. Emp.*, 1923, xxx, 2[illegible]5–129.

Carcinoma of the urethra is a rare disease, only about 100 cases having been reported up to the present time.

Total resection of urethra and partial resection giving bad results, the author had his 2 cases treated by radium. In the first case, the growth disappeared and several glands were removed and found to contain cancer cells.

In the second case, the growth was made smaller but had not disappeared.

WINTZ, H. Forecare and aftercare in roentgen-ray therapy. *Radiol.*, 1923, i, 74–81.

Generally speaking, special clinics for roentgen-ray treatment do not exist. "As a result of the rather simple therapeutic procedures from which deep therapy has developed, ambulatory treatment is still widely prevalent.

"Thus it occurs that the forecare and aftercare of patients treated by deep therapy is only rarely placed in the hands of the roentgen therapist."

Efficient deep therapy cannot be restricted to the application of a quantity of rays, but must take account of all the circumstances which concern the avoidance of injury and strengthening the body in its fight with cancer. It is the duty of the roentgen therapist to instruct the associate physician and prescribe rules for the patient.

1. *Forecare.* Certain demands are made of the attending physician and of the patient which must be executed before treatment is instituted, which are just as important as the preparation for an operation. These depend on the nature of the disease and the plan of treatment.

When a patient is to be treated the physician is told of the method and probable duration of such treatment. If the patient is transferred to the roentgen-ray treatment clinic, further management by the attending physician becomes unnecessary. However, if the case is sent in by the house physician only for irradiation and leaves the clinic immediately after the treatment, instructions must be given the attending physician. These comprise verification of the diagnosis, and actual preparation for irradiation. All specimens should come to the laboratory of the roentgen-ray clinic.

A complete physical examination should be made with an exhaustive anamnesis, including the condition of the skin in the rayed area, the heart and the blood picture.

In raying mammary cancer, a thorough examination of the lungs is of prime importance.

With a leucocyte count under 2,500, in conjunction with a lymphopenia and a hemoglobin index below 40 or 35 per cent, a cancer treatment should under no circumstances be given.

Iodine applications and mercury treatment make the skin intolerant to the roentgen ray. Basedow's disease shows an excessive sensitiveness of the skin, in which it is increased about 25 per cent, also certain types of diabetes and some forms of kidney disease.

When intestinal disturbances are present we prefer to wait a few days rather than irradiate the patient in such a condition.

2. *Aftercare.* There are four great factors resulting from irradiation to be met:

(1) Care of injuries ensuing upon roentgen therapy, which may be classified as general and local.

(2) Elimination of degeneration products resulting from disintegration of tumor cells, and neutralization of toxic metabolic products in normal cells.

(3) Support of the body to secure an enduring resistance against cancerous disease.

(4) Replacement by healthy tissue at the site of the cancer.

Irradiation injuries may be classified in two groups, local and general. Among the general, blood changes play an important rôle.

The gravity of local tissue injury depends on the amount of radiation used and the condition of the tissue. Special attention must be paid to the possibility of combination injury, which is one that only appears when the irradiated tissue is acted upon by some additional agent. There is a specific result of the roentgen-rays, a *locus minoris resistentiae,* produced in the rayed tissues. This occurs even with 50 or 60 per cent of the erythema dose, in which no tissue change is found. But if such a tissue is acted upon by a second irritant, changes appear out of proportion to the amount of the second agent.

The degree of lowered resistance is increased as the dose approaches the limit of tolerance. For this reason we forbid the use of hot water bottles, electric pads, radiated heat, and sunlight after roentgen-ray treatment, and we also forbid application of an ice bag. Moderate heat under some circumstances is tolerated, but even baths at a temperature of 38 or 39° C. may be irritative. We also forbid the use of all chemical salves or rubs (iodine, vasogen), or washing with benzine, benzol or terpentinol. All forms of pressure, such as that from collar bands, coat collar, and garters on the irradiated area must be avoided. Likewise chafing from clothing or rubbing corset steels, pulling or scratching the irradiated area.

The induction of a *locus minoris resistentiae* holds true for every type of tissue.

Irritations of the bladder and altered chemical composition of the urine may give rise to combination injuries. Concretions in the bladder cause unpleasant results.

There is always a possibility of combination injuries to the rectum, especially when the fecal matter passing through the irritated areas is very hard. Therefore, the condition of the bowels is to be watched very closely.

Among the local irritations which offer the possibility of combination injury are those of the oral and pharyngeal mucosa. For a few days after irradiation of cancer of the larynx there is always the possibility of edema of the glottis. In the tongue there is a chance of combination injury by food. Neither very hot nor very cold food should be taken.

Induration of rayed tissue almost always occurs if a certain area is irradiated two or three times, even at long intervals, with a dose which approaches the toleration point (90 to 100 per cent of the erythema dose). Any rough handling of this edematous induration must be avoided.

Induration of the lung, which frequently follows systematic irradiation of mammary cancer, must also be considered. While in general it is harmless, and under no circumstances requires active after-treatment, it is of importance to recognize, especially if inflammatory processes occur (bronchitis, pneumonia), which run a more severe course than in sound lungs. The only medicament of value is camphor. This lowered resistance of the lungs is often dangerous in attacks of influenza.

General damage which follows every irradiation results from the biochemical action of the roentgen rays, and in some tumors, from the liberation of degeneration products from the cells acted upon by the rays. The basis of so-called roentgen sickness is in these intoxications. Irradiation of the abdominal organs is usually followed by marked sickness. The presence of nitrous acid and, above all, ozone and its compounds, tends to increase this trouble.

It is of importance that the bowels be thoroughly cleansed out for some days preceding the irradiation, so that they will be empty during treatment.

The effects are often very severe if the patient undertakes a railway journey after intensive treatment.

Blood changes hold a special place among the general effects. They stand in direct relation to the amount of radiation received by the body. For blood injury, on the other hand, the amount of radiation absorbed by the entire body must be taken into account. In order, therefore, to establish a comparison between roentgen-ray intensity and the amount of blood injury, we have taken a volume-dose as a unit. This unit, designated "A," corresponds to the amount of radiation received at 180 kv. with a 0.5 mm. zinc filter, at 23 cm. focal distance, in a pyramid of tissue with a base of 6 by 8 cm. and a height of 15 cm. With this the skin will receive an erythema dose. With 2½ or 3–A the first blood changes appear, which, however, quickly vanish.

With an amount of irradiation such as is used in uterine cancer, there is a lowering of the hemoglobin, and marked decrease in the number of leucocytes, especially lymphocytes. Coagulation time is affected. With high intensity, it is shortened; with less intensity and if the dose is divided by about ten-hour intervals, coagulation time is lengthened. About six weeks are required to restore the original blood picture.

Since 1914 we have not seen a single case in which a patient died as a result of acute blood destruction. The blood should be watched closely; it gives the best indication of the progress of the case. Blood transfusion sometimes betters the general condition.

The problem of raising general body resistance can be solved only by close cooperation between the house physician and the clinic. General dietetic management is also necessary.

A satisfactory result in cancer treatment does not depend alone on proper and thorough *irradiation*. A well-conducted aftercare decides the result, and even apparently simple cases present new problems which must be taken seriously, for their final solution requires much experience.

Scholtz, Moses. Precancerous skin lesions. *Calif. State J. M.*, Aug., 1923, xxi, 334–336.

A thorough familiarity with the clinical characteristics of precancerous lesions is imperative in the prevention of cancer. The tendency of a lesion to become cancerous is brought about by three factors: (1) old age; (2) damaged or changed structure of the tissue; (3) chronic mechanical, chemical, or biochemical irritations. The continued presence of these three factors is usually sufficient to stimulate a precancerous lesion into malignancy.

Senile keratoses are the most frequent sources of malignant degeneration. Richard Sutton divides this group into three parts: first, seborrheic keratosis developing from seborrheic patches; second, nevoid keratosis, springing from nevi; third, strictly keratotic type, starting from the horny layer of the epidermis.

The roentgen ray can clear up all of the senile keratoses. Radium shows all the advantages and limitations of roentgen ray. Like the roentgen ray it should be applied to selected cases.

Leucoplakia, arsenical keratoses and scars also serve as precancerous beginnings.

Aikins, W. H. B. Some results of radium treatment in sarcoma. *Canad. M. Assn. J.*, Sept. 1923, xiii, 654–656.

A myeloid sarcoma of the tibia formed a secondary deposit in the groin. After microscopic diagnosis it was submitted to heavy radiations. Ten days later tissue removed for examination showed the large cells of the growth had changed into connective tissue cells and spindle cells. The cells showed necrosis and necrobiosis. The connective tissue cells had been mobilized and the leucocytic infiltration was most intense.

Dominici says of this change following radium treatment of a vascular myeloid sarcoma that the malignant cells are destroyed by the rays and replaced by fibrous tissue, but that the sarcoma cells themselves are converted into cells indistinguishable from normal connective tissue. The lumen of the blood-vessels became smaller, so that they appeared like capillaries lying in the fibrous tissue.

When treating these conditions, avoid breaking the skin because of the dangers of infection. For deep seated growths, he uses the *gamma* rays of radium, employing flat, heavy screened applicators, the dose varying with the extent and location of the lesion.

In superficial sarcoma the *beta* rays are more satisfactory. Tubes and applicators are superior to needles in such cases.

Results in lymphosarcoma are not encouraging. In lymphogranuloma the response to radium is good, with certain striking exceptions. Osteosarcomas do not respond well to radium.

Epulis and myeloid sarcoma of bone are most suitable for treatment by radium. In melanotic sarcoma the prognosis is not so good, as metastasis is practically inevitable. In angiosarcoma the effect of radium is most satisfactory. Sarcoma of the conjunctiva responds most remarkably.

Heiman, Henry. Exophthalmic goiter in childhood with some unusual manifestations. *Am. J. Dis. Child.*, Sept., 1923, xxvi, 216–222.

The Mayo Clinic found in these cases of exophthalmic goiter three-tenths of one per cent of children under ten years of age.

The sympathomimetic symptoms may be developed by stimulation of the thoracolumbar division of the involuntary nervous system. The ultimate cause of the disease then must act primarily or secondarily through the involuntary nervous system.

In 182 cases of exophthalmic goiter in adults, Sandiford found an average basal metabolic rate of +51 per cent.

The roentgen ray has given some favorable results. Means and Holmes in 44 recent cases of exophthalmic goiter treated with roentgen ray, report 28 patients improved. Of these 12 were apparently cured, 16 improved, but not entirely well. In no instance was a case made worse. In the favorable cases there was a rapid fall in the pulse rate (from an average of 115 to 89) and basal metabolism (from an average of +55 to +21 per cent).

Radium emanations have been used by Terry in exophthalmic goiter, mainly in preparation for thyroidectomy. Of 16 patients, 2 were cured by radium alone; 10 were well after resection of thyroid and 4 died after operation.

Pemberton, John DeJ. The end results of surgery of the thyroid gland. *Arch. Surg.*, July, 1923, vii, 37–46.

In 1922 in the Mayo Clinic 1,983 operations were performed on 1,497 patients with goiter with mortality from operation of 0.95 per cent, and by case of 1.2 per cent.

Classification of operable thyroid condition:

(1) Diffuse colloid goiter—the common physiological thyroid enlargement in adolescence, producing no symptoms beyond those of pressure. Iodine deficiency being the etiological factor.

(2) Adenoma without hyperthyroidism. In a small proportion of cases enlargements are entirely concealed in the thoracic cavity. Operative procedure is the only effective remedy.

(3) Adenoma with hyperthyroidism. This is not to be confused with exophthalmic goiter. The symptoms of hyperthyroidism usually occur spontaneously and develop gradually but progressively. These symptoms may be induced abruptly by the administration of iodine to a patient with adenoma without hyperthyroidism. The operative mortality is between 2 and 4 per cent. Judd found after two years 83 per cent considered themselves cured and 5 per cent more were markedly improved.

(4) Exophthalmic goiter. This is characterized by an increased basal metabolic rate, by a peculiar nervous syndrome and usually by exophthalmos, with a tendency to gastric intestinal crises of vomiting and diarrhea. The cause of exophthalmic goiter is unknown but there is always the characteristic pathologic picture of diffuse parenchymatous hypertrophy and hyperplasia in the thyroid gland. Operation has particular danger just before, during, and following a crisis.

In 1922 there were 1,093 operations on 633 patients with exophthalmic goiter in the Mayo Clinic; 11 died; operative mortality of 1.005 per cent; by case, 1.74 per cent.

Wilson found in the Mayo Clinic 1 case of malignancy in 57. Recent rapid growth in the thyroid suggests malignancy. Wide surgical removal followed by radium or roentgen ray offers the best chance.

In a study of 207 cases of malignancy to January, 1921, the Mayo Clinic gave:

Sarcoma	19 cases	no cures.
Carcinoma	62 cases	5 per cent, five-year cures.
Malignant Adenoma	102 cases	20 per cent, five-year cures.
Malignant Papilloma	24 cases	33 per cent, five-year cures.

Béclére, H. Injections of lipiodol. *Bull. et mém. Soc. radiol. méd. de France*, June, 1923, xi, 177.

The author cites 4 cases in which the presence of lipiodol in the tissues interfered with interpretation of roentgenograms. In the first case the injection had been made several years previously into the gluteal muscles and completely obscured the region of the hip joint and in the second case a similar muscular injection in the deltoid region obscured the shoulder-joint. In the third case injection in the lumbar region led to operation for calculus in the kidney. The fourth case was an injection in the back which at first glance appeared to be an advanced pulmonary lesion.

Hanks, Mary Elizabeth. The roentgen ray in non-malignant gynecologic cases; a clinical study. *Radiol.*, Oct., 1923, i, 82–86.

Technique: 9 in. spark-gap (125,000 volts); 7 to 12 in. distance (18 to 30 cm.); 5 ma; 5 mm. of aluminum with sole leather as filters; five to seventeen minutes' time.

The cross-fire method is employed, through as many ports of entry, 3 in. in diameter, as are required to cover the disease under treatment.

The skin being rated at 100, the dose for the ovary is only 35 or less, while the other glandular tissues and also the myoma cell, are all below 100. Not only do we get with the fractional dose the reactions we seek, but we more often avoid symptoms of roentgen sickness arising from too rapid disintegration of the tissues.

The author quotes Holzknecht as follows: "Among my cases of strongly rayed myomata 5 developed hyperthyroidism, 4 hypertension, 2 distinct acromegaly and many gave clinical indications of marked ovarian irritation. Whereas, similar cases that were rayed feebly showed surprisingly excellent recovery, characterized by the absence of any untoward secondary endocrine effects."

Contraindications to roentgen treatment are as follows:

1. Pedunculated tumors are unsafe and should be operated upon.
2. Submucous tumors are unsatisfactory, provoke complications and are surgical.
3. A tumor associated with severe anemia, much tenderness and with history of fever and chilliness may be necrotic and is at once surgical.
4. A chronic tumor that suddenly grows rapidly may be undergoing some form of degeneration and is better operated upon.
5. A tumor associated with ovarian tumors (not simple follicular cysts) belongs to the surgeon.
6. A suspicion of malignancy puts the case into the hands of the short-wave expert, the radiologist or the surgeon or all of them.
7. A case associated with acute gonorrheal infection, with salpingitis or pyosalpinx, is not benefited by the roentgen ray.
8. A large non-vascular tumor, made up mainly of connective tissue, that does not bleed, is unfavorable for excellent results with roentgen ray though these cases may yield good results as to health and comfort.
9. A woman who desires children and whose subserous tumors can be enucleated, is a good subject for myomectomy.

MOHLER, HENRY K. Basal metabolism, the value of its estimation. *Ann. Clin. Med.*, 1923, ii, 39–41.

Today the best laboratory procedure which has been developed as an aid in the recognition of thyroid disturbance is the determination of the basal metabolic rate. It is of value as a guide to the proper treatment, whether medical, surgical, roentgen-ray or radium. All investigators agree that the basal metabolic rate varies with thyroid activity. Although the pituitary and the ovary influence basal metabolism they do so to a much less degree. Pernicious anemia, leucemia, severe diabetes mellitus and cancer may increase the basal metabolism, and starvation and wasting disease may decrease it.

The interference with the thyroid gland by surgical procedure has resulted in hypothyroidism in addition to the original disease. To this group belongs the large number of cases of so-called disordered action of the heart seen in soldiers during the recent war, patients suffering from neurocirculatory asthenia, nervousness, loss of weight, incipient tuberculosis, syphilis and gastrointestinal disturbances.

It must be remembered that the basal metabolic rate will not measure the degree of impairment of the kidneys or the heart that may be associated with impaired thyroid function.

LEVY, ROBERT L. The size of the heart in pneumonia. A teleroentgenographic study, with observation on the effect of digitalis therapy. *Arch. Int. Med.*, 1923, xxxii, 559–585.

This investigation was undertaken to obtain by roentgenographic methods the size of the heart at frequent intervals in pneumonia cases. Teleroentgenograms of the chest were made every second day, or as nearly so as the condition of the patient warranted, in 21 cases of lobar pneumonia and 8 cases of bronchopneumonia. Three normal young men, and one with fever due to acute bronchitis and pulmonary tuberculosis served as controls.

Method of taking the roentgenogram: Half second exposures were made during inspiration, in the recumbent position, at a distance of 2 meters. In order to record graphically on the plate the phase of respiration in which the exposure was made, a lead strip was secured to the plate holder with adhesive plaster to indicate the neutral position of the vertically hanging lever of a Marey tambour, the lever being tipped with a solid knob of lead. The tambour was connected by means of rubber tubing with a Politzer bag, held in position in the right axilla of the patient by a linen binder secured by fastening its tails. During respiration, the lever of the tambour swung on one side or the other of the neutral strip. The side to which the lever deviated during expiration was denoted by a letter. The pictures were obtained during inspiration in the majority of cases. To verify the anteroposterior alignment, a thin lead strip was placed over the spinous processes of the vertebrae and two acute angles of lead were secured anteriorly, one in the suprasternal notch and the other in the substernal angle; in later plates the posterior strip of lead was omitted, as the spines could be plainly seen.

New technique for completing the outline of the cardiac silhouette. From the plates, the diastolic outline of the right and left borders and the midline were traced on paper. This made possible the measurements of transverse and long diameters. The angle of inclination of the heart—that is, the angle formed by the long diameter, and a line drawn to the apex at right angles with the median line—was also recorded. Instead of completing the silhouette by arbitrarily joining the ends of the lines defining the borders, a simple geometric construction was adopted, which rendered the procedure entirely objective. In the illustration reproduced herewith, the heavy lines *ad* and *be* represent, respectively, the right and left borders traced from the roentgenogram. With the distance *ab* as a radius with *a* as a center, an arc was drawn, and with the same radius with *b* as a center, another is drawn intersecting with the first at *C*; from *C* as a center with *ab* as a radius *a* and *b* are joined. The arc was constructed in like fashion employing *de* as the radius and *f* as a center. The area so delineated was measured by a planimeter.

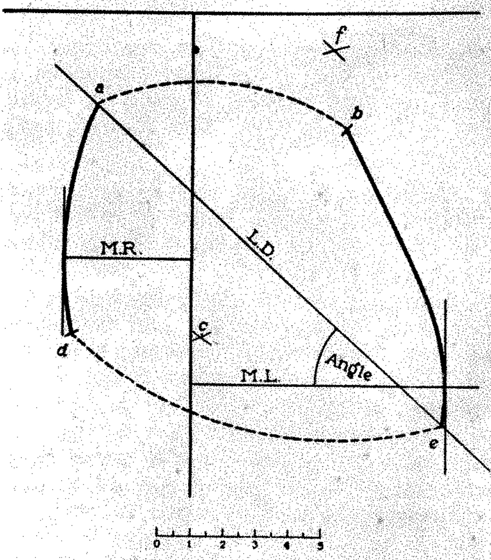

FIG. 1. Construction of the cardiac silhouette, showing area, diameters and angle.

It is evident that if the distance *ab* and *de* are constant in value, the areas bounded by these lines and their corresponding arcs must be constant in value, and variations will be accompanied by variations in area. The subjective arbitrary construction formerly employed may therefore be replaced by one which is objective, even though arbitrary, in its variations.

The control series was obtained by using normal young men, plates being taken every second or third day until six or seven had been made. Measures from these roentgenograms show that the maximum variation in transverse diameter was 0.6 cm., in the long diameter 0.4 cm. and in area 8 sq. cm.

The effect of fever and tachycardia on the size of the heart was shown by measurements of the heart in a case of acute bronchitic and pulmonary tuberculosis, but without signs of consolidation of the lungs. The maximum variation in transverse diameter was 0.7 cm., in long diameter 0.2 cm. and in area 1 sq. cm.

It seemed reasonable, on the basis of the findings, to regard as a significant change in the outline of the heart a variation of 1 cm. or more, in one of the diameters, or of 10 sq. cm. or more, in the area. Usually, when a change was observed, it took place in all measurements, and was of a greater order of magnitude than the minimal criteria established.

Results in pneumonia: The 21 cases studied presented varying degrees of severity. The usual types of organizations were present. Thirteen cases (61.9 per cent) showed an increase in the size of the heart during the illness. Digitalis was given to 10 of the cases by mouth in the form of digitan. Of the 11 not receiving digitalis, 8 (72.7 per cent) showed cardiac enlargement; of the 10 receiving the drug, 5 (50 per cent) showed cardiac enlargement.

From these facts it appears that in about 62 per cent of these cases of lobar pneumonia. cardiac dilatation occurred during the course of the disease, and that cardiac dilatation occurred less frequently in the patients who received digitalis than in those who did not.

The order of magnitude of change is of interest. In the patients not receiving digitalis, the increase in transverse diameter was from 4.5 to 15.4 per cent (average 9.3 per cent), in long diameter from 4.4 to 13.5 per cent (average 8.2 per cent), in area from 11.6 to 27.1 per cent (average 16.5 per cent). In the digitalized patients who showed enlargement, the increase in transverse diameter was from 3.6 to 19.2 per cent (average 11.0 per cent), in long diameter, from 2.6 to 19.7 per cent (an average of 10.2 per cent), in area from 11.1 to 37.3 per cent (an average of 1.5 per cent). The difference in the two groups is not striking.

The averages in the second group are increased by the figures obtained from a patient with Type III pneumococcus infection involving the entire right lung and the left lower lobe. In this man, critically ill, the transverse diameter fell from 13.6 cm. at the height of the disease to 11.4 cm. during convalescence, the long diameter from 17.0 to 14.2 cm., the area from 136 sq. cm. to 99 sq. cm.

SUMMARY

1. A teleroentgenographic study was made of 21 cases of lobar pneumonia and 8 cases of bronchopneumonia, employing a special technique in making the plates and a new method in completing the outline of the cardiac silhoutte.

2. In lobar pneumonia, cardiac dilatation occurred in 61.9 per cent of the cases. Dilata-

tion was less frequently observed in patients who received digitalis (50 per cent) than in those to whom the drug was not given (72.7 per cent).

3. In bronchopneumonia, cardiac dilatation was less frequent than in lobar pneumonia, having been observed in 25 per cent of the cases. The two patients in this group who received digitalis showed no dilatation.

4. The heart muscle in pneumonia may attempt, by lengthening its muscle fibers, to augment systolic output. Digitalis in therapeutic doses increases the contractile power of the ventricles. On the basis of these facts, early and adequate digitalis therapy is suggested in pneumonia, in the belief that the drug may exert a beneficial effect, not only in the presence of auricular fibrillation and flutter, but also when the normal rhythm prevails.

SIEVERT, ROLF M. A "radium compensator" for ionization measurements. *Acta Radiol.*, 1923, ii, 156–165.

An instrument is described for rapid observations of the intensity of β and γ rays. The apparatus is constructed primarily for medical use.

The ionization current in a small chamber is compensated by means of another similar chamber, the latter together with a sensitive electrometer being placed in a lead box. The ionization in the compensation chamber is produced by the β rays from a radium preparation, containing about 0.2 mgm. radium element. The compensation is brought about by increasing or decreasing the distance between the preparation and the last-mentioned chamber accordingly, until the electrometer thread remains in its zero position, irrespective of a switch for earthing being disconnected or not. The distance is read off on a micrometer.

Investigations of the possible error sources show that the measurement of one intensity can be made in twenty seconds without a greater error than ½–2 per cent depending upon the magnitude of the intensity.

FLEMMING-MÖLLER, P. The roentgen picture of interlobar exudates and pleural thickenings especially with regard to the differential diagnosis of tuberculous infiltrations in the upper right lobe. *Acta Radiol*, 1923, ii, 139-154.

By the roentgen examination one cannot, as most authors suppose, obtain an absolutely reliable basis for the existence of an interlobar exudate. Of course, the exudate gives quite a characteristic shadow picture, but tuberculous infiltrations in the base of the upper lobe, which is commonly seen in roentgen examination of phthisis, as well as simple bronchopneumonia may give exactly the same picture. The roentgen examination can only lead to a supposition that it is a question of interlobar exudate, but the diagnosis can only be made in connection with the clinic and a reliable result only obtained through a positive issue of a test puncture.

A well-defined lower border of the shadow argues more in favor of an infiltration than of an exudate, whereas an upper well-defined border rather gives one to presume an exudate, as processes of infiltration are not met with so frequently in the upper part of the middle lobe. When interlobar indurations of the pleura are seen, one must absolutely direct one's attention to an eventual tuberculosis of the lungs.

SONNE, CARL. Investigations regarding the condition of the white-blood corpuscles in guinea-pigs and rabbits exposed to irradiation with visible rays. *Acta Radiol.*, 1923, ii, 116–127.

By irradiation of white, shaved guinea-pigs and rabbits with visible, luminous rays a perceptible effect on the condition of the white-blood corpuscles is proved.

In guinea-pigs an immediate decrease in the number both of lymphocytes and leucocytes occurs, but this is most pronounced for the former. Later, when the irradiation has ceased, an increase in the number of lymphocytes occurs in the course of a few days, so that this number exceeds the normal for some time. Coincidentally the number of the polynuclear leucocytes seems to be, if anything, normal.

These changes correspond to those found by Murphy and Sturm with regard to the temporary influence of dry heat on rats, mice, and guinea-pigs.

In rabbits, forty-five minutes after the irradiation, there is a very considerable increase in the number of the polynuclear leucocytes, simultaneously with a generally somewhat smaller decrease in the number of the lymphocytes, so that the normal, strongly pronounced lymphocytic form has in the course of two to three hours become leucocytic. Next day the form is again normal, so that it can once more be affected in the same manner by a new light-bath.

BAASTRUP, CHR. J. Some remarks on proc. post. tali. *Acta Radiol.*, 1923, ii, 166–175.

1. After a fract. proc. post. tali one may see fragments joined to a large and plump bone projection, which may cause the patient great inconvenience owing to the plantar flexion being diminished on account of the mechanical disproportion.

2. Such large proc. post. can also be found to be congenital.

3. Effective assistance can be rendered only by operative removal of the process.

4. With fracture of the hindmost edge of tibia one ought to inspect proc. post. tali, as this is possibly fractured at the same time, and conversely, with fracture of proc. post. tali one should remember that the hindmost edge of tibia may be broken.

WEGGE, KAI. Two unusual cases of multiple ureteral calculi. *Acta Radiol.*, 1923, ii, 264–267.

The author describes 2 cases of multiple ureteral calculi. In both cases there is a considerable number of stones, but 1 of the cases presents a very unusual picture, inasmuch as one of the ureters is closely packed with stones from the pelvis of the kidney right down to the bladder.

BAKKE, S. N. Spondylitis typhosa. *Acta Radiol.*, 1923, ii, 176–181.

The author describes a case of spondylitis typhosa, the clinical picture of which answers closely to the case described by Quincke as to the following cardinal symptoms: 1. The remarkably intense and diffuse, local pains. 2. The acute course. 3. The rapid abating of the spinal pains. 4. The noticeable swelling of the soft parts of the vertebral column. The roentgenogram is different from that seen in spondylitis tuberculosa. First of all there is no marked atrophy of lime and no destruction of the vertebral body. Parallel with the pathological process present in the body of the vertebra there is a proliferating process going on, with a bridge-like connection between the second and third vertebrae. The articular space between these two vertebrae is reduced. After fully three months a more transparent portion of the vertebrae is seen on roentgenograms in profile, a sequestrum(?) being discernible in that portion.

The process did not react to tuberculin injections.

SIEVERT, ROLF M. Secondary rays in radium therapeutics. *Acta Radiol.*, 1923, ii, 268–300.

The physical facts which seem to be of interest when studying the problem of secondary radiation in radium therapeutics are stated.

Some mathematical laws with regard to secondary radiation are fixed in order to give a general view of the distribution of this radiation.

By means of an instrument previously described in *Acta Radiologica*, investigations were made as follows:

(1) The secondary radiation from screens of different materials and thicknesses placed in various positions between a radioactive substance and the ionization chamber.

(2) The secondary radiation measured with different kinds of ionization chambers.

(3) Secondary radiation from water volumes in different positions.

The results of the measurements in (1) seem to agree with those of other investigators.

Lastly, some questions are briefly treated which may be of interest in radium therapeutics, the following facts being emphasized:

(1) The wall of the ionization chamber should be comparatively thick (for example, 2–5 mm. ivory) when investigating the distribution of intensity.

(2) Secondary radiation is of practically no importance when emitted from tissue outside a sphere with a radius equal to the distance between the applicator and the part exposed, and with its center just between these two.

(3) When treating at a distance, the secondary filter should be placed just between the applicator and the skin, thereby giving a minimum of secondary β radiation.

Wisdom is the daughter of experience. LEONARDO DA VINCI.

Never believe what a patient tells you his doctor has said. JENNER.

For one mistake made for not knowing ten are made for not looking.

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CANCER THERAPY FROM THE SURGEON'S STANDPOINT*

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INTRODUCTION

WE are accustomed to regard the roentgenologist and the radium therapist as aids to the surgeon. If the advances in roentgen and radium therapy continue at the pace at which they have been demonstrated at this meeting, I think we will have to call the surgeon an aid to the radiologist.

When we look back some twenty-five years and then note the resources that we have today in treating cancer, we must, even the most pessimistic of us, admit that we are very much nearer to the solution of the problem than ever before. The only drawback that I can see is that we do not discover how to *prevent* cancer. Although some statistics seem to prove that cancer is on the decrease, it is almost certain that it is still on the increase. I believe the solution of 'the problem will probably come from some source other than surgery or radiology, and that in the near future we will have human immunization of the body against cancer by serums or possibly through eugenics.

The main difficulty apparent in the discussion on cancer, is the fact that we are not able without material injury to the neighboring normal tissues, to deliver into the cancer field a sufficient dose of roentgen or radium rays to destroy every cancer cell. The problem which I think should be dealt with is not so much that of adjusting the proper dose, as that of making it possible to use very much smaller dosage of rays to accomplish the same result.

We have in the body two kinds of tissues, the "stationary" and the "circulating" tissues. When the rays are concentrated on one small area of a patient's body, practically all the blood in his body is exposed to the radiation because the blood contained in the tumor at one time circulates through the body, and each time it passes through the radiated area, to which it is exposed.

The reason why superficial tumors and growths respond quickly to radiation, is that it is possible to apply the radioactive substance directly into the growth itself without material injury to the rest of the body. In deep-seated tumors the problem is different. The overlying tissues must be penetrated by the rays before the seat of the trouble can be reached, and thus the dosage must be much larger.

In order to solve this problem, I have for years advocated the removal of the overlying tissues and as much of the tumors as possible, and then the introduction of the radioactive substance, either radium or roentgen rays, directly into the tumor mass. This method accomplishes two objects; viz., it prevents general infection and toxemia. If a tumor is locked within the body, it must be liquefied before it can be eliminated. It cannot be absorbed into the circulation and then eliminated through the excretory organs until every cell has been broken down.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18-21, 1923.

THE APPARENTLY HOPELESS RECURRENT CARCINOMA AND SARCOMA: WHAT CAN BE DONE FOR THEM?

The various phases of this question are discussed under the following heads:

1. The necessity of cooperation of surgeon and radiologist.
2. Why the deep-seated carcinoma does not yield as readily to radium and roentgen-ray treatment as the superficial.
3. Transformation of deep-seated tumors into superficial ones, preparatory to radiotherapy.
4. Morphologic and biologic changes of normal and cancer cells after radiation.
    (*a*) Stimulation of growth.
    (*b*) Sterilization of cells.
    (*c*) Necrosis of cells.
5. Theory of relative radio-sensibility of normal and cancer cells.

Let us first define what is meant by "apparently hopeless." The combination of the two words seems a contradiction. If something is hopeless, there should be no "apparent" attached to it. However, the fact that we often find surprising improvement in hopeless cases leads us to be guarded in pronouncing a case *entirely* hopeless.

I have come to the conclusion that surgeons are entirely too pessimistic; that we have not yet exhausted all our efforts and that in the apparently hopeless cases, more may be done. With this attitude, I desire to make a few suggestions.

I shall confine myself to the advanced cases in which surgical operation is inadvisable or in which one or more surgical operations had been performed, and recurrence had taken place. In choosing such material for our work, we must not become discouraged. We cannot expect the impossible. Neither must we enter upon this work in a half-hearted way. If we do, we are apt to fail in doing our best. We enjoy other advantages in choosing this class of cases in that we obtain cooperation with our patients, and if we fail we are not likely to be reproached. If we succeed in only a few cases, we shall have accomplished something.

1. *The necessity of cooperation of surgeon and radiologist.*

The pessimistic attitude toward cancer therapy is gradually diminishing. This is due mainly to the acquisition of a helpful ally to surgery, namely, radiotherapy.

It is only within the past five years that the use of radium and the roentgen ray have found any respectable recognition in the treatment of malignant growths. Previous to this their value was doubted, and the favorable reports of radiologists were met with suspicion, and even treated with scorn. This was quite natural, because there were only a few men in the country who were competent to apply these agents with precision. Many applied them regardless of dosage and with indifference as to the scientific methods of directing the rays into the field required. Therefore, the results were only temporary, and the constant recurrences in reported cures were a great disappointment to the hopes of surgeons and the public. In the meantime, radiologists of note have made important improvements in technique and thus have brought these remedial agents into recognition. Many a skeptical surgeon has now become an enthusiast. One is impressed with the increase of contributions in radiology when he compares the recent programs of the medical conventions with those of five years ago.

A review of the non-operable methods of treatment of inoperable carcinoma, issued by my brother, Dr. Joseph C. Beck, in the December, 1912, number of the *Index of Oto-Laryngology*, cited the following methods that had been employed since 1895:

1. Bacteriotherapy
    (*a*) Bacterial products.
    (*b*) Immunizing process.
2. Chemotherapy
    (*a*) Arsenic-atoxyl, salvarsan, arsacetin.

- (*b*) Kankroin.
- (*c*) Antituman.
- (*d*) Quinine, formalin, resorcin, kolargol.
- (*e*) Metals.
- (*f*) Cholin.

3. Physical Means
    - (*a*) *X*-rays.
    - (*b*) Radioactive substances, as radium, mesothorium, thorium X.
    - (*c*) Fulguration.
    - (*d*) Diathermia or desiccation.
    - (*e*) Electrolysis, Finsen light, heliotherapy, carbon dioxide snow.
4. Miscellaneous Agents
    - (*a*) Pharmocological substances.
    - (*b*) Organotherapy.
    - (*c*) Ferments and anti-ferments.
    - (*d*) Circulatory destruction.

None of these, with the exception of the roentgen ray and the radioactive substances, has stood the test of time, and today practically all of them have been given up as inefficient. One of these methods, however, has not yet had a sufficient trial, namely, the immunizing serums. It is quite possible that in the future, experimental work will lead to immunization against cancer growth.

Surgery and radiotherapy dominate today the field of cancer work, and for these two alone shall I speak in this paper.

The surgeon of today may well speak with authority on the cancer question. He has had the benefit of generations of experience. His slogan is: "*Operate early and radically*, or you render no service to your patient."

Radiology is not a competitor of surgery. Its claims are modest enough when we consider what it has already contributed to cancer therapy. Roentgenologists are greatly handicapped, however, because surgeons do not collaborate sufficiently with them. How much more efficacious this treatment would be, if both surgeon and roentgenologist were to correlate their work, and work hand in hand.

In former times the surgeon referred to the roentgenologist only those cases for which he believed surgery could do nothing further. He advised radium and the roentgen ray merely as a means of satisfying the unfortunate individual and making him believe that something was being done for him.

Today the attitude is changed. The surgeons expect more of the roentgenologists. They now decide that in certain cases radiotherapy is preferable to surgery. In many large clinics, carcinoma of the cervix is now treated with radium instead of surgery. The same is true of carcinoma of the prostate, while postoperative roentgen treatment is gradually being adopted by the most conservative surgeons in the country.

2. *Why does the deep-seated carcinoma not yield so readily to radium and roentgen-ray treatment as the superficial.*

The literature supplies us with sufficient evidence of the fact that superficial malignant growths such as epitheliomata may be eradicated by either the roentgen ray or radium when no metastases are present or when lymphatic glands are not involved.

Quite different is our experience with deep-seated cancers. When the radioactive substances can be placed in close proximity to or in contact with the growth itself, the results are more encouraging: but in cases, for instance, of carcinoma of the pancreas, the liver, or the stomach, the results have thus far been unsatisfactory. There are a number of reasons for this, the principal one of which is that the overlying structures, such as the skin, the fat, the muscles and the bones, act as barriers to the penetration of the rays. This has been verified by experiments. In October, 1919, I published some experimental work on this subject which proved the above-stated fact.

Radium, as well as the roentgen rays, produces rays of various wave-lengths and consequently of varying penetrating power. The hard rays are the more penetrating. Radium emits three varieties of rays, the *alpha*, the *beta*, and the *gamma*. The *alpha* rays constitute about 91 per cent, the *beta* about 7 per cent, and the *gamma* only 2 per cent. The *alpha* rays cannot be considered in radiotherapy since they are absorbed in the glass receptacle in which the radium is enclosed. Rutherford states that $^{6}/_{1000}$ in. of aluminum or a sheet of thin writing paper will absorb all the alpha rays. The beta rays are about one hundred times more penetrating than the alpha, and nearly all will be absorbed by 5 mm. of aluminum or 1 mm. of lead. These rays are useful in radiotherapy, and their action may be controlled by proper screening. The gamma rays are from ten to one hundred times as penetrating as the beta rays; these are the rays that play the most important part in radiotherapy. The knowledge of the penetrating power of these three varieties of rays is a practical guide in the proper application of radium.

The thickness of matter required to absorb a certain quantity of rays is inversely proportional to its density. It requires, for instance, 20 mm. of aluminum to absorb as many rays as 1 mm. of brass. The same rule applies to living tissues. Skin will filter more rays than fat, and bone more rays than skin. Roentgen-ray shadows produced on photographic plates by different substances of equal thickness give us an approximate index as to their density. The density of any substance depends upon the close packing of the molecules of which it is composed. Metals, such as gold, have a greater density than wood or flesh, because the gold molecules are packed more closely.

The essential requirements for a favorable result lie in the ability to deliver into the cancer a dosage of rays sufficient to destroy the life of each and every cancer cell without material injury to the adjacent normal body cells. In other words, we must define the topographical dimensions of the growth and project into this field a quantity of rays which must be no larger and no smaller than is required for cancer-cell destruction. Too large a quantity of rays will no doubt destroy the cancer cell, but it will at the same time injure normal cells adjacent to the cancer field to such a degree as to pave the way for more extensive cancer invasion.

In order to accomplish this difficult task, we must calculate our dosage not merely by the output of the machinery or the milligram hours, but by correct deduction of factors which increase or diminish the dosage actually reaching the seat of the disease.

If the growth be deep-seated and covered with a thick layer of tissues, such as the skin, fat and muscle, a large percentage of rays will be absorbed by these structures. To this loss of radiation we must add another loss—that caused by the artificial filter which it is necessary to place upon the skin in order to prevent burns. If the operator interposes 1 mm. of lead and a layer of leather to protect the skin, the lead alone will absorb 99½ per cent of the beta rays and about 7 per cent of the gamma rays. At times the operator also interposes what is called a distance block, a small block of wood or other light material upon which he fastens the radium capsule, to keep it at a distance from the skin. This procedure adds still another loss of radiation.

These combined losses of radiation due to artificial filters, the intervening tissues and the distance block, reduce the efficiency of the radioactive substance considerably. A far greater loss, however, is occasioned by the dispersion of the rays from the radium capsule in all directions, when it is placed on the surface of the body. Only that cone of the rays which passes toward the body, is then utilized, and the rays which pass laterally upward are lost. If the same quantity of radium were placed in the center of the growth, all these combined losses of radiation would be avoided. A given amount of radium placed within the growth will produce an amount of active radiation many times as great as when placed on the surface of the skin at some distance from the tumor.

To make this clearer, I illustrate this principle by two sketches of a chest with a centrally located tumor (Figs. 1 and 2).

Figure 1 indicates that the radium is placed on the surface of the body, and Figure 2 that it is in the center of the tumor. One can see at a glance the difference in action of the radium in the two instances.

For convenience, we have divided the entire sphere into sixteen cones of equal size; each cone, therefore, represents 1/16 of the output of the radium emanation. We must consider, however, that this estimates only the rays emanating in one plane. To calculate more correctly, we must take into account the rays which emanate laterally from the radium.

In Figure 1, where the radium is placed on the surface of the body, only two cones, Nos. 9 and 10, reach the tumor; the remainder of the cones are dispersed in other directions. We note, also, that only the gamma rays reach the tumor—the beta rays have been absorbed by a screen of 2 mm. of lead and the overlying tissues, and have heretofore been entirely useless in this application.

Comparing this with Figure 2 where the radium is placed directly in the tumor mass, we find that all sixteen cones are projecting their rays into the tumor itself, and that the beta rays, which are most useful, are fully utilized.

It is thus evident that when treating deep-seated carcinoma through overlying tissues, we are obliged to use much larger quantities of radium in order to deliver into the tumor itself sufficient dosage. By placing the radium directly in the cancer bed much smaller doses are sufficient. By reducing the quantity of radium, the normal structures will be spared, with consequent reduction of the danger of producing toxemia.

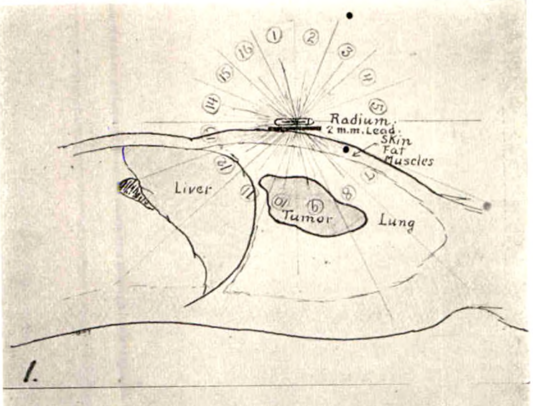
The following factors are to be taken into account in the correct application of radium:

1. Placing the radium at a distance from the growth diminishes the activity.
2. Placing artificial screening of lead or leather over the skin filters out the most effective rays.
3. A further reduction of activity of the rays is produced by an additional absorption of rays by the skin and underlying tissues.
4. Only a small percentage of the radiation enters the field to be treated; the remainder is lost by scattering in other directions.

3. *Transformation of deep-seated tumors into superficial ones preparatory to radiotherapy.*

Having come to the conclusion that the deep-seated carcinoma is resistant to radiotherapy because of the difficulty of delivering a sufficient quantity of rays into the seat of the disease without undue injury to the rest of the body, I have attempted to solve the problem by converting the deep-seated carcinoma into a superficial one—in other words, to expose the tumor to direct radiation. This requires of course, a surgical operation.

Such surgical procedures must often of necessity be very extensive and, therefore, must be attended with some risk. A halfway procedure is useless in such cases. It was a surprise to us, however, to find that the immediate mortality was not so large as one would expect. It is not necessary to describe the technique, because this varies in each case and the illustrations which accompany the case reports give sufficient information. If the principle appeals to the trained surgeon he will be able to devise his own plan in each case. The principle of the surgical procedure is as follows: *We remove the skin and fat, the muscles and other overlying tissues, and as much of the growth as is safe or possible.*



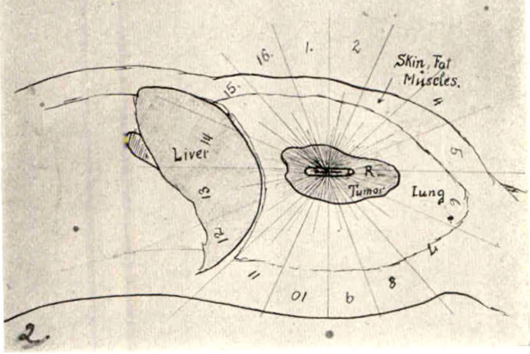


Fig. 1. Illustrates the small number of cones penetrating the tumor when radium is placed on the skin.

Fig. 2. Illustrates the difference in distribution of rays when radium is placed within the seat of the tumor.

At times it is possible to remove the tumor entirely, leaving a perfectly clean field with no visible remnants of the growth. At other times it is possible to remove only a part of the growth, because it is attached to or embedded in vital organs. No attempt should be made to diminish the size of the wound by sutures. The wound is left open for subsequent applications of either roentgen ray or radium, as the case may require. This procedure practically converts a deep-seated growth into a superficial one, which is therefore favorable for treatment. With this large area widely open, we may now apply either the roentgen rays or radium placed directly in the bed of the disease. It becomes unnecessary to do any material screening, especially when there are thick layer of the disease tissue left, because we have by this procedure eliminated the danger of skin burns and may with safety place radium in direct contact with the tissues which we wish to destroy. Screening becomes necessary only when we have exposed large blood vessels, vital organs, or nerves. These must be protected during radiation. The dosage of radiation employed may now be reduced to a fraction of the quantity which would have been required had the application been made through the skin, for reasons already mentioned.

This method of combined treatment, namely, the removal of overlying tissue and the direct applicationof the radioactive substances, has now been carried out in a variety of cases, sufficient in number to support certain conclusions. For illustration, we shall cite a few from a series of more than 100 cases. In each case here illustrated, will be brought out some point of information relative to the appliance of this method.

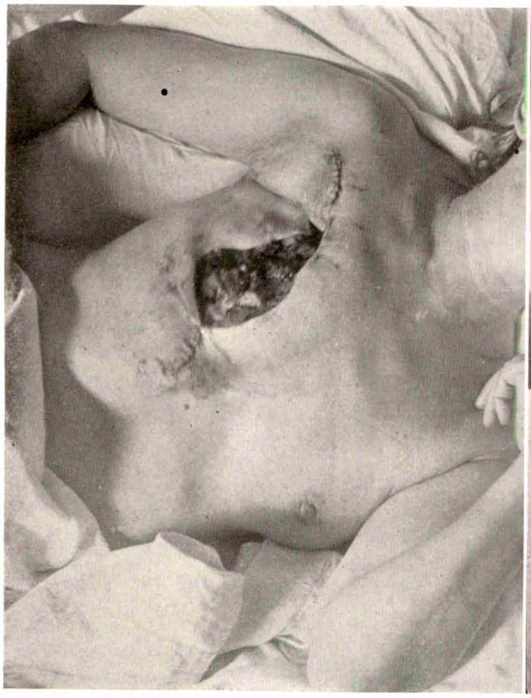


Fig. 3. Wound left open after resection of cancer of the breast for subsequent radiation.

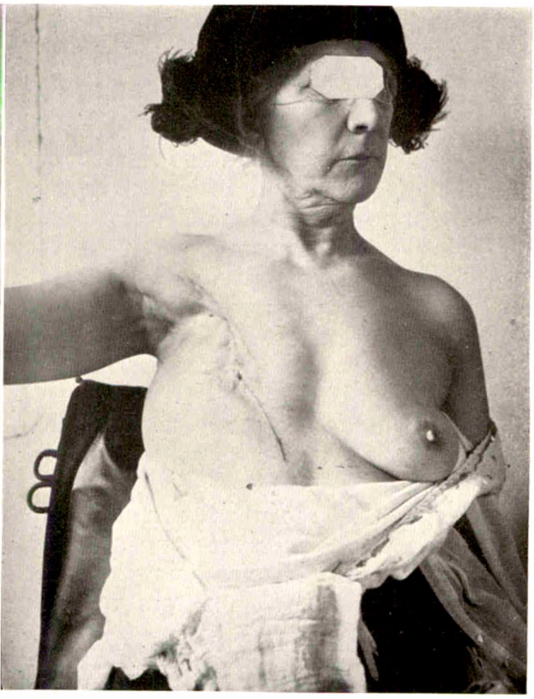


Fig. 4. Healing of wound without secondary sutures (scar movable).

TECHNIQUE EMPLOYED IN PRIMARY CARCINOMA OF THE BREAST

Figure 3 illustrates the open wound after the resection of the right breast and the axillary glands. The vessels in the axilla were protected by a few sutures of the upper flap, but the radium was inserted underneath this flap subsequent to the operation. As a rule we do not put in any sutures in the lower end of the wound; we leave a much larger area exposed than is shown in this case. Figure 4 shows the same case as it appeared two years after the operation. The wound is contracted, the scar tissue is not adherent to the chest wall and can be lifted up just the same as the normal skin.

Comment: This technique has been carried out in primary resections of carcinoma of the breast only; in cases of recurrence the operation is much more radical. I desire to illustrate the procedure in such a case.

PROCEDURE IN RECURRENT CASES

Female, admitted to the hospital October 25, 1921, with a recurrent carcinoma of the breast. She had been operated upon about a year previously.

Her physical condition was good. In the line of incision of the breast wound were a large number of nodules. The axilla was filled with recurrent carcinoma, adherent to the chest wall. The lungs were not involved.

The operative procedure in this case is illustrated in Figure 5, which shows the complete resection of the pectoral muscles, with clearing out of the axilla to the lower border of the clavicle. This large space was left entirely open for subsequent treatment with roentgen ray and radium. For several weeks the wound continued to retract and there was no evidence of recurrence. This is shown in Figure 6. The final result of this case, however, was unfortunate—the patient died from recurrence about a year later.

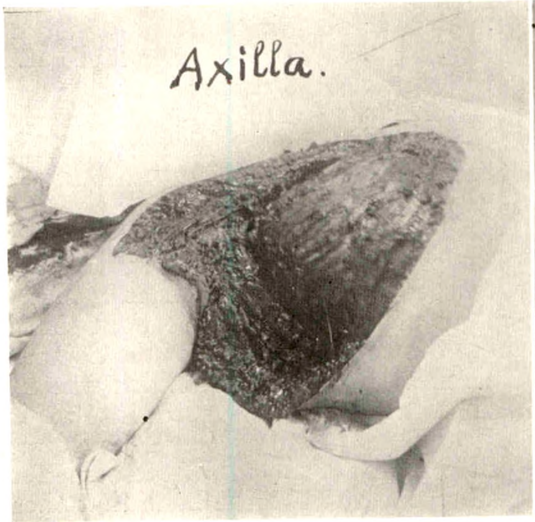


Fig. 5. Radical procedure in secondary operation after recurrence in the axillary space. Wound left open.

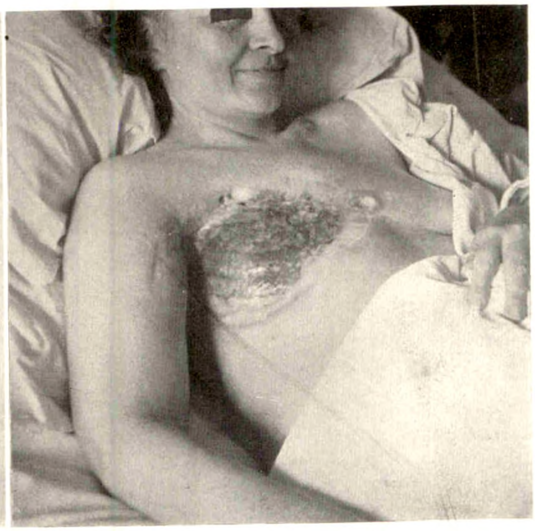


Fig. 6. Gradual regeneration of skin and contracture (without suture). Three weeks after operation.

CARCINOMA OF THE BREAST—METASTASES IN THE PELVIS DESTROYING THE RIGHT RAMUS OF PUBIS—RESTORATION OF THE BONE AFTER RADIATION

This case is exceedingly interesting because of the complete regeneration of 2 in. of the pelvic rim subsequent to the disappearance of the tumor in the pelvis.

The patient is aged forty-two, married fifteen years, has had four children, normally delivered, without forceps. Injury to the pelvis during childbirth is excluded. She has had three miscarriages. In November, 1922, she came into the hospital complaining of a tumor in the left breast, which in the past year had grown to the size of a fist. Her second complaint was pain in the right hip. She walked with a limp, and during the last month she has been hardly able to walk at all.

Examination of the chest revealed a typical carcinoma of the breast with involvement of the axillary glands.

The pelvis contained a tumor mass in the right iliac fossa, not movable—adherent to the pelvic bone. This was evidently a metastatic carcinoma. A roentgenogram of the pelvis shows distinctly an absorption of the right ramus of the pelvic bone (Fig. 8). This extraordinary finding was corroborated by repeated roentgenograms.

The patient was advised to have a radical operation for the breast carcinoma, but to depend upon roentgen treatment for the pelvic tumor, because this was considered inoperable. On November 7, 1922, the breast was radically removed, the axillary glands being completely eradicated, and the wound left *entirely open* for subsequent radium and roentgen treatment. The roentgen treatment for the pelvic condition was carried out in the Radiological Department of the North Chicago Hospital under the direction of Benjamin H. Orndoff, M.D. The report of dosage given by him is as follows:

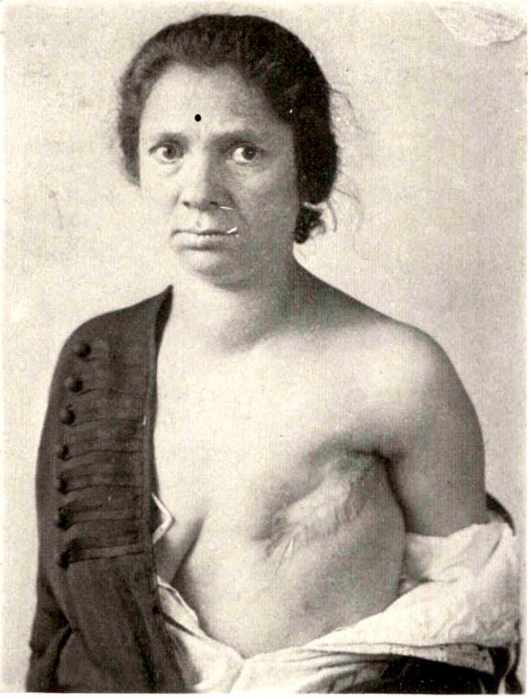


FIG. 7. Patient one year after operation, scar movable; no recurrence in breast nor pelvis.

> "The *x*-ray treatment was divided and administered in three series. The duration of each series was five days. The second and third series were administered after an interval of four weeks. The technique was: voltage, 200 kv.; filter, 0.75 mm. cu. plus 1 mm. Al.; skin-anode distance, 50 cm.; portals, 20 × 20 cm.; milliampere minutes, 480 per portal, during each series. Three portals were used, one anterior and two postero-lateral. Epilation occurred following the first series. Marked tanning followed the second series, and there was considerable scaling and some painful erythema following the third series. Eight weeks later there was some evidence of subcutaneous fibrosis, more marked on the posterior portals. The patient developed *x*-ray sickness following the first series, which lasted for a few days. Practically no further undesirable symptoms were noted during the treatment."

At the present time (nearly a year later) there is no recurrence, either in the breast or in the pelvis. The wound in the breast is now entirely covered by skin, as shown in Figure 7. While the patient has not yet regained her former state of health, she is able to walk without the limp, has no pain in the pelvis nor in the hip, and has perfect motion in the hip joint.

Roentgenological Check-up on Changes of the Bony Pelvis. In comparing the roentgenograms of the pelvis taken before and after deep therapy, we find quite a surprising change. Figure 8 represents the condition before the treatment was instituted. It shows distinctly that the ramus of the pubis on the right side had been destroyed by the growth. Comparing this now with Figure 9, which was taken ten months later, subsequent to deep therapy, we notice a complete restoration of the ramus of the pubis, and so perfect is the regeneration of the bone that there is scarcely any difference between the left and the right side.

A similar case was reported by Dr. George E. Pfahler in August, 1922, in which a second lumbar vertebra, destroyed by metastatic carcinoma, was recalcified by the influence of the roentgen treatment This regeneration of bone subsequent to roentgen treatment is positive indication that carcinoma cells do not exist in this particular field.

OSTEOCHONDROSARCOMA OF THE RIGHT CHEST CAVITY AND WALL

Case Report. Male, aged sixty-five, was referred with the following history: A few years ago the patient had a slight automobile accident. Soon after a small cartilaginous tumor appeared between the ribs and the sternum. A year later the tumor began to degenerate, and grew to such an extent that it bulged out of the upper part of the chest. An attempt was made at home to remove the tumor, but when it was found that it penetrated 4 to 5 in. into the chest cavity, the attempt at removal was abandoned. After this operation the tumor began to grow very rapidly.

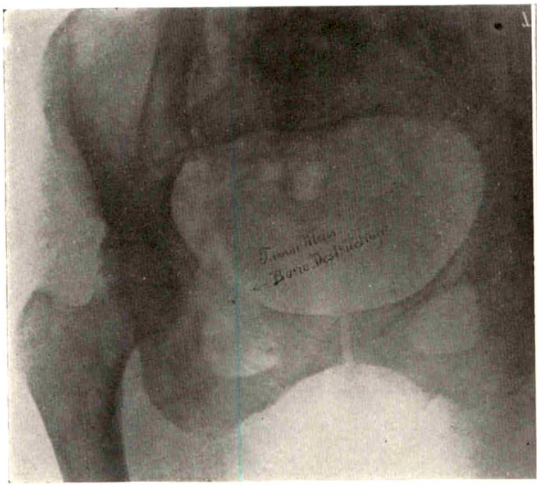


FIG. 8. Roentgenogram of pelvis showing destruction of ramus of the pubis (metastatic carcinoma).

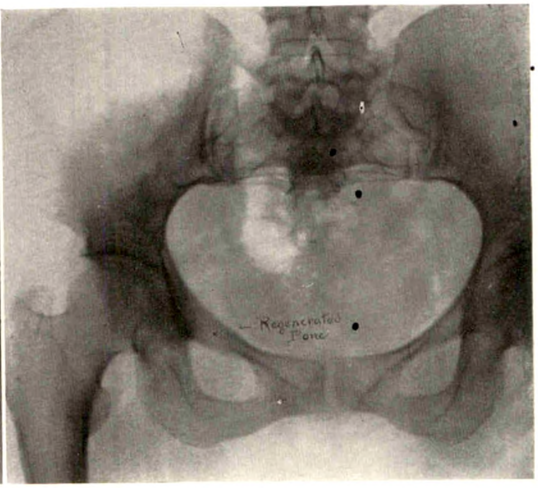


FIG. 9. Same as Figure 8, ten months later; ramus of pubis regenerated (subsequent to deep therapy).

The patient was seen by me on April 20, 1923. Figure 10 gives a good idea of the extent of the tumor. It involves the clavicle, sternum and several ribs. The roentgenogram (Fig. 13), gives a very clear picture of the depth and extent of the tumor, showing also that the first, second and third ribs are partly destroyed, as well as the upper half of the sternum and two-thirds of the clavicle. The tumor fills out the upper half of the right chest, displacing the lung downwards. The patient consented to a radical operation, which was done in two steps.

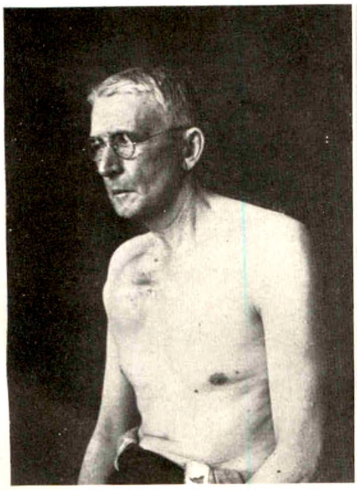


FIG. 10. Osteochondrosarcoma involving chest wall and one half of right chest cavity.

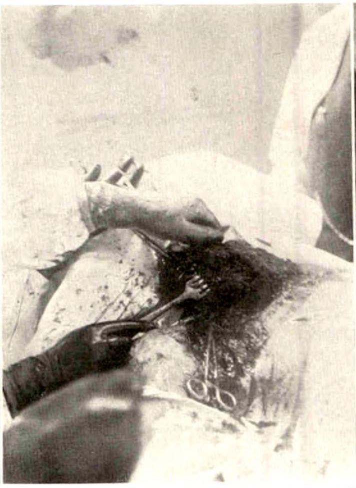


FIG. 11. Removal of first, second and third ribs—clavicle, sternum and the tumor (wound left open).

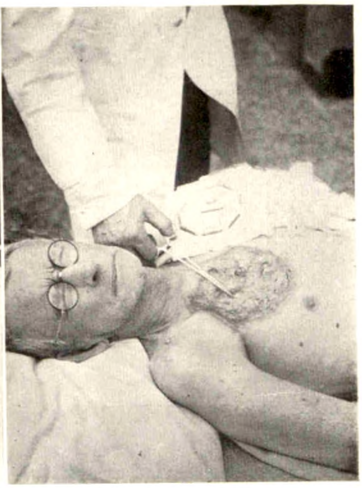


FIG. 12. Gradual contracture of the wound following radium treatment. Re-expansion of the lung.

First operation: May 8, 1923, the second and third ribs, the sternum, and as much of the tumor as was possible, were removed.

Second operation: Two days later the operation was completed by resection of the clavicle and the first rib. Fortunately, the subclavian artery and vein were not injured in this operation, although they were in proximity to the growth. This operation produced a very large open wound, extending from the right axilla to the left edge of the sternum and from the neck down to approximately the fifth rib. The cavity was very deep, because the greater part of the tumor had been enucleated as shown in Figure 11.

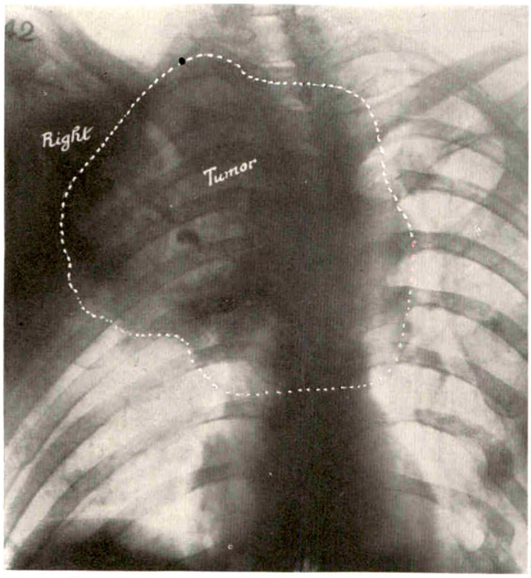


FIG. 13. Roentgenogram of chest showing size and location of tumor.

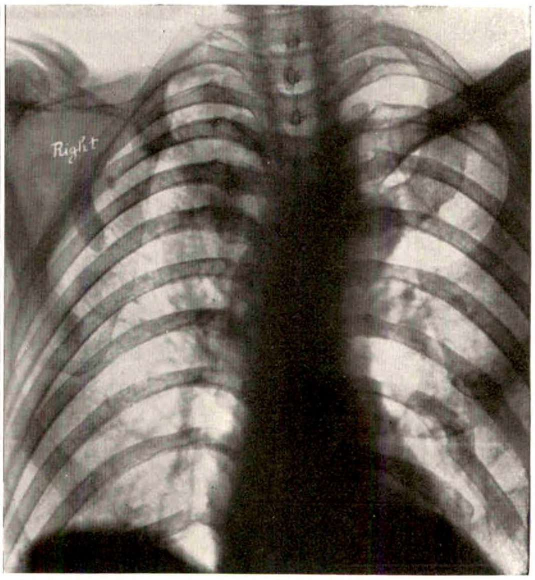


FIG. 14. Roentgenogram taken six weeks after operation showing absence of tumor. Lung re-expanded.

Three days later the first application of radium was made. Six needles, amounting to 150 mg., without screening, were placed in the depth of the tumor for 1,400 mg. hrs. There was no toxemia following this application. Since that time the application of radium has been as follows:

Date	Mgm.	Hrs.	Mgm. hrs.	Location
6/16/23	75	3	225	Placed in the depths of tissue to diminish the sloughing
7/ 5/23	50	4½	225	Depth
8/ 5/23	100	8	800	Superficial
8/ 7/23	12½	4	50	Depth
8/16/23	37½	6	225	Depth
8/23/23	200	7	1,400	Superficial
9/18/23	100	9	900	Superficial

Roentgen treatment was not employed in this case.

The wound began to contract and skin regenerated rapidly from the edges sc that at the present time the wound is only about one-fourth of its size at the time of operation (Fig. 12). The lung has evidently re-expanded, inasmuch as the granulating surface seems level with the chest wall, whereas in the beginning there was a deep cavity. This fact is fully illustrated in a roentgenogram (Fig. 14), taken six weeks after the operation. It not only shows that the tumor has been entirely eradicated, but that there is no recurrence. The entire chest cavity is now occupied by healthy lung.

The patient's general condition is satisfactory although thus far he has gained slowly. It is too early to state whether or not this will be a permanent cure, but the case is here illustrated for the purpose of showing our method of attack upon a condition which otherwise would be entirely hopeless.

4. *Morphologic and biologic changes of normal and cancer cells after radiation.*

(*a*) Stimulation of growth

(*b*) Sterilization of cells

(*c*) Death of cells

A thorough knowledge of the histological changes in the tissues produced by radiation is not merely a matter of scientific interest, but also of extremely practical value. Indeed, it is the foundation of, and a necessity for, successful therapy. At first it appears a simple matter to obtain from the literature and one's own experience an up-to-date résumé of this subject, but as we begin to analyze the work of many investigators we meet with such a volume of special investigations that we can mention here only those facts which seem essential for practical purposes in this work.

NORMAL TISSUES

In the application of radium or roentgen ray, we must take into consideration the fact that the body consists of two kinds of tissues: First, the stationary, such as bones, muscles, secretory, excretory, and digestive organs, the connective tissues, etc.; and second, the migratory or circulatory tissues, such as the red cells, the leucocytes, lymphocytes, etc.

When radiation is concentrated upon a certain area in the body, the rays bombard the stationary tissues in this area but inasmuch as the blood stream flows through the radiated part, the cellular constituents of the blood receive a charge from the radiation as they pass through. It is thus evident that deep therapy affects the entire volume of blood in the body.

Normal body tissues are not equally affected by radiation. Some varieties are only slightly injured by radium or the roentgen ray, except when very large doses are applied. The cornea, for instance, is only slightly radiosensitive, and brain cells are spared when intracranial tumors are being successfully treated by radiotherapy.

Dr. Isaac Levin,[1] in his report on the action of radium on circulating blood of turtles and frogs, found that the lymphocytes are more radiosensitive than the leucocytes and the erythrocytes, and that radiation produces a release of polymorphonuclear leucocytes from the bone marrow, or an over-production of the same by the blood-forming organs.

This specific radiosensibility of lymphocytes explains the action of radium and roentgen rays on normal and diseased lymphoid tissue. The destruction of the lymphocytes in the lymphoid tissue is associated with endarteritic obliteration of blood vessels, resulting in the formation of dense connective tissue.

PATHOLOGIC TISSUES

Normal lymphoid tissue is less radiosensitive than the various types of hyperplasias and lymphomas. Tuberculous glands are less radiosensitive than neoplastic tissues. Hodgkin's disease is extremely radiosensitive. Enlarged spleen shrinks to normal size under radium and roentgen influence. Lymphosarcoma is influenced more promptly than any other form of lymphoid hyperplasia. Enlarged thymus and mediastinal tumors also yield readily.

The changes in carcinoma cells from radiation were studied by many investigators, especially by Haendly of Bonn.[1] He compared microscopic sections from the carcinoma rayed for three weeks with specimens of the same tumor which had not been rayed, and found that the rayed specimen contained small groups of carcinoma cells which were surrounded by connective tissue. Furthermore, the carcinoma cells in the rayed specimen were closely packed and the nuclei were much larger in proportion to the cell bodies. The individual cell was larger and flat, and on account of the large amount of protoplasm in each cell, the entire specimen seemed much paler. Under larger magnification it seemed edematous and did not take the stain uniformly. The nucleus of one cell took the stain very dark so as to obstruct the structure of the cell, while a number of finer other cells were full of vaculoes and stained faintly. Even the protoplasm varied in its intensity of staining, one cell being brighter than another. The outlines of the cells were rather sharp.

Karyokinetic changes were not frequent after radiation, but at times there was an increased proliferation. Further changes took place in cases in which radiation was kept up for a long period. The carcinoma cell-groups began to diminish in size; the connective tissue increased, and in a great many of the cells there were fine black specks, something like dust, sprinkled throughout the cell body. This was, no doubt, due to the disintegration of the nuclei. In some instances the nucleus would become smaller and smaller until it finally disappeared and nothing but the protoplasm was left, which finally also disintegrated. Some of the cells, however, remained almost normal.

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[1] LEVIN, I. Action of radium and roentgen rays on normal and diseased lymphoid tissue. *J. Am. M. Ass.*, September, 1921, lxxvii, 930.

[1] HAENDLY. Strahlenwirkung mit Hinblick auf die sog. "elektive wirkung" Strahlentherapie, A. f. Guor., 1918, Bd. 109 S. 409.

Dr. Joseph Beck and myself have been able to verify the findings of Haendly in several cases of carcinoma which had been radiated. I desire to cite a case in which these findings were vividly demonstrated. The case was first reported in October, 1919.

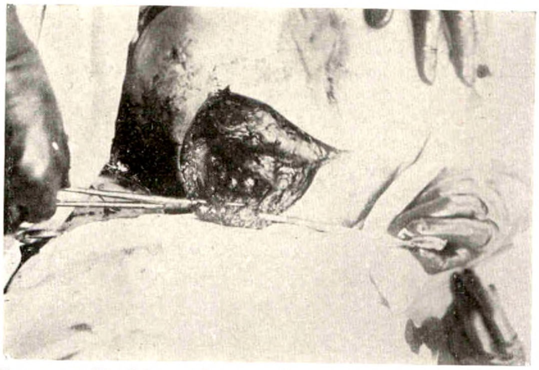

FIG. 15. Excision of supraclavicular glands. Wound left open for subsequent radium treatment.

Female, aged forty-eight, a doctor, married; developed carcinoma of the left breast in June, 1918. In September, 1918, the breast was amputated, with radical removal of all glands below the clavicle. Roentgen treatment was given after the operation, but recurrence of carcinomatous glands above clavicle took place. I decided then to remove the skin, fat, and all cancerous involvement within reach above the clavicle. This was done on January 21, 1919. The clavicle was entirely exposed, and as much diseased tissue above the clavicle as was feasible was extirpated. The wound was left open (Fig. 15).

Through the open wound roentgen and radium treatments were applied. Within a few weeks the entire wound was covered with dry skin. The patient had been gaining weight at the rate of 1 to 2 lbs. a week since that time. Several months later I noticed a gland in the supraclavicular region about the size of a hazelnut. We were uncertain as to whether or not it was carcinomatous as the patient continued to gain. After this gland reached the size of a pecan nut, it stopped growing and remained stationary for one year. The patient's condition remained unchanged; she was able to keep up the strenuous work of her medical practice. In November, 1920, I demonstrated her before the Southern Medical Association, and called attention to this gland on her neck. I stated that I did not consider this gland malignant, although it might have contained cancer cells. This statement seems a contradiction. I mean by this that the cancer cells had lost their reproductive power through the influence of radium, and, although the cellular structures were not destroyed by the radium, they were sterilized and thus became benign in their character. The patient, upon return from this meeting, consented to an excision of this gland for microscopic examination. This was done in November, 1921, and two more glands of the same size were found deeper in the supraclavicular space. The examination of this gland again verified the characteristic findings of Haendly, and the microscopic section is herewith shown.

Low power. There is a great increase of the connective tissues surrounding cancer nests with breaking down of the cancer cells (Fig. 16), in some instances forming a homogeneous mass.

We note that there is an infiltration of the connective tissue surrounding the group of carcinoma cells, and a narrow space between the cancer nest proper and the connective tissue.

High power. The carcinoma cells themselves are typical, as described by Haendly, the nucleus is broken down, and the cell body looks as though pepper were scattered over it (Fig. 17).

STEREOSCOPIC MICROPHOTOGRAPHY

At this point I desire to mention the marked advantage I have obtained by studying the microscopic slides of these encapsulated cells by means of the *stereoscopic method*. By employing this method we obtain not only a true picture of the depth of the various layers of cells, but also a much clearer definition of the cellular as well as the fibrous structures.

I have succeeded in reproducing these stereo-micro-sections on paper so that they may be studied by means of the parlor stereoscope. I desire to illustrate here the first stereo-microphotograph which I have been able so to reproduce (Fig. 18). If the reader will take the trouble to cut out this picture and view it through the stereoscope, he will behold a view entirely new to him. He will observe that the whole specimen resembles a transparent slice of a certain thickness of tissue composed of several strata of various cellular or fibrous elements in their relation to one another.

In this particular specimen we find a number of small sacks within the interior of which are packed a large number of cells. These cells are the carcinomatous remnants which have been incarcerated by connective tissue growing around groups of cancer cells, undoubtedly Nature's effort to exterminate them or to keep them from reproduction. The stroma in which these sacks are embedded is a reticulum of connective tissue which has replaced the carcinomatous cells.

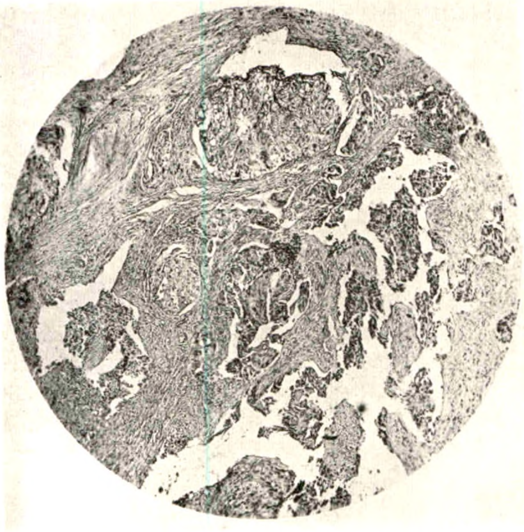
Fig. 16. Microscopic section of the supraclavicular glands after radiation.

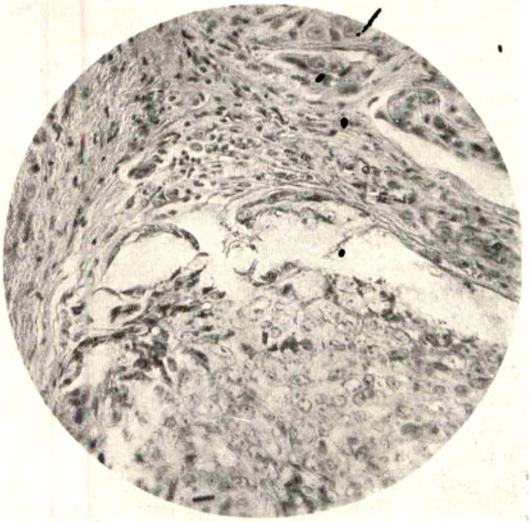
Fig. 17. High power.

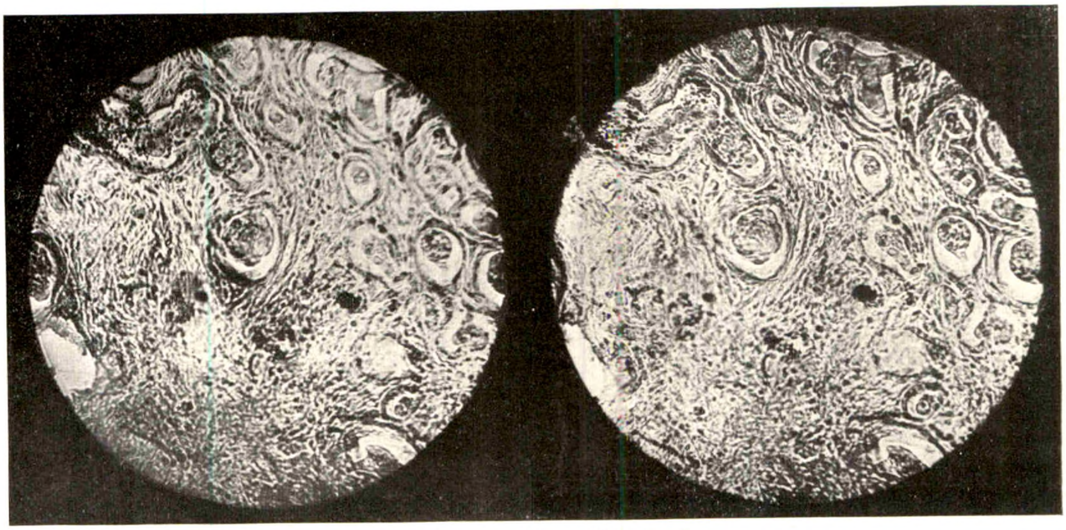
Fig. 18. Stereo-photo-micrograph.

In the single slide we lose all the perspective—all cells seem to be in one plane. I therefore recommend that all sections be studied by means of the stereo-micro-photograph.

An endless amount of work has been done to determine the lethal dose of the cancer cell, but up to date a definite dosage has not been established. We can say, however, that investigators have reached the point where they can tell approximately what a lethal dose should be. In this connection we desire to cite the conclusions reached by Drs. Francis Carter Wood and Frederick Prime,[1] of New York City, who base their conclusions on very extensive experimental work at the Crocker Research Laboratory of New York:

> "The practical conclusion which may be drawn from these observations is that the amount of roentgen ray necessary to kill all the cells of a rapidly growing, very cellular, and highly malignant sarcoma or carcinoma in man, is between five and seven erythema doses of filtered roentgen ray, when the tumor is on the surface of the body. Every centimeter of tissue that covers the tumor makes an additional amount of roentgen ray necessary. For example, when slices of fibroid uterus are used as absorptive material, the galvanometer deflections show that at a depth of 2 cm., 19 per cent more roentgen ray is required; at 5 cm. depth, 47 per cent more, and at 10 cm. depth, 65 per cent more."

Before we accept the conclusions drawn by different investigators, we must bear in mind that it is absolutely inpossible to determine the lethal dose for a carcinoma cell because not all cancer cells are equally radio-receptive. Some types of carcinoma cells are more easily destroyed by small dosage and exposure than other varieties; in other words, the biological factor must not be lost sight of.

5. Theory of relative radiosensibility of normal and cancer cells

Radium and roentgen rays when applied in too large a dose will destroy normal as well as pathological cells. It requires, however, much larger dosage of rays to destroy a normal cell than would be required to destroy a cancer cell. It has been stated that both these agents have a selective action on certain cells, especially on embryonic or cancer cells.

This supposition is probably erroneous. Rays have no selective power for certain cells. They bombard all tissues alike, but the cancer cell has less resisting power against injury from the rays than the normal cell, and therefore succumbs more readily. In other words, the cancer cell is more radioreceptive. It is, likewise, more easily injured by other agents, such as heat. Cancer cells are destroyed at a temperature 15 to 30° lower than is required for the destruction of most normal tissues; thus in applying graduated heat in carcinomatous regions the cancer cells will perish while the normal cells will withstand higher degrees of temperature.

An explanation for this lack of resistance of the cancer cell is desirable. Many theories have been advanced, some of which are quite reasonable, others less so. One of the most favorable theories is the embryonal. The cancer cell is considered to be an embryonic cell, and since all embryonic cells are less resistant than the mature cells, they succumb more readily to the roentgen rays. This assertion brings up another question. How long does an embryonic cancer cell remain embryonic? All cellular structures before they become mature pass through the embryonal stage, just as human beings do. Whether or not the same law prevails in the case of cancer, I do not know. Is it possible that a cancer continues to increase in size, and all its cells remain embryonic?

Normal cells belonging to the body organization pass through the embryonal stage, become mature, fulfill their function, and when they are old, they are broken down, liquefied and eliminated, and replaced by new cells (metabolism). Does this also take place in the case of cancer, or does the cancer cell reproduction go on indefinitely without being broken down, until exposed to external injuries, such as roentgen rays, heat, surgery, or accidents? If the rays are really more injurious to all embryonal cells, whether they be the normal or cancer types, it would be a most dangerous procedure to expose the body to the ray, because it would destroy the normal embryonal cell, which would practically mean gradual cell extinction. There must be some other factors in operation which give the normal cell a greater protection against radiation or other injurious agencies.

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[1] WOOD, F. C. and PRIME, F. Lethal dose of roentgen rays for cancer cells. *J. Am. M. Ass.*, 1920, lxxiv, 308–312.

A study of this question requires a critical inquiry into the biologic phenomena and the etiologic factors of cancer. Unfortunately our knowledge on these two questions is still meager, but let us make deductions from what knowledge we possess up to date.

We must accept one logical conclusion, namely, that cancer is derived from the normal cells of the body. Since our entire organism is derived from one single cell, and no foreign cells are introduced into the body from the outside, we must conclude that the cancer cell is a child of the normal cell.

The question now arises: What causes this abnormal cell proliferation? What conditions are necessary to change a normal cell into a cancer cell? Loeb states that all conditions which produce a cell proliferation, through mechanical, physical, or chemical stimulation, that continues for a relatively long period of time, may be the cause of this transformation.

Fibiger was able to produce cancer in the stomach of rats by feeding them Nematode Spiroptera Neoplastica. Yamagira produced cancer of the skin in rabbits by a long-continued application of tar, and others produced the same on mice with this method. Marie and his associates have produced sarcoma in rats by long-continued application of the roentgen ray. Tissues which normally are not able to proliferate do not produce cancer. Loeb and Slye believe, and have demonstrated, that heredity is an important factor in production of cancer. They can, by selective mating, foretell not only which offspring will develop cancer, but they can also state which organ will be affected. These experiments are convincing and must be taken into account when we wish to get at the cause of cancer. We have now learned that several factors play a part in the causation, two of which are most conspicuous, namely, external and internal stimuli, and heredity.

Are both necessary for the causation? Is one sufficient? Loeb believes that either cause is sufficient, although when both are present the chances for cancer are much greater.

When we consider, however, that nearly all early operators with the roentgen ray developed carcinoma of the skin by the constant exposure to the rays, we realize that it is not likely that these operators were all predisposed by heredity to carcinoma; thus heredity alone is not an absolute requirement for cancer growth.

Loeb does not believe that microorganisms are directly causing cancer, but he does not deny the possibility.

Sivertsen and Dahlstrom[1] recently published a series of experiments to prove that the production of cancer depends a great deal upon muscular activity, or, rather the lack of it. They state, and prove by statistics, that people who are engaged in active muscular exercise, such as teachers of gymnastics, rarely get carcinoma, while the sluggish individuals and people of sedentary habits are more predisposed to it.

Whatever the actual cause or causes of cancer growth may be, the fact remains that the cancer cell, if not morphologically different, nevertheless is, and acts differently from the normal cell.

In my previous publication I advanced a theory which may not only throw additional light on the cause of cancer, but also may show why cancer cells succumb quickly to roentgen ray and radium and other injurious agents. A mass of cancer cells may be likened to an alienated, detached and lawless community, the members of which have no other function than self-nutriment and reproduction. It may be compared with an insurgent state or a group of revolting individuals, often found in peaceful communities, who do not wish to perform any labor and ask for everything that labor produces. They, too, appropriate plenty of nutriment for themselves in a lawless manner. A parasitic community. They know how to appropriate for themselves plenty of nourishment at the expense of the whole community, *but do not give any counterservice to the organism in return for the nutriment they receive.* These cells grow in a lawless manner without any definite arrangement of structure or function.

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[1] SIVERTSEN, IVAR, and DAHLSTROM, A. W. The relation of muscular activity to carcinoma. *J. Cancer Research,* 1921, vi, 365-378.

Is it not reasonable to expect that these recalcitrant cells (cancer cells), *which render no service to the whole, are denied the same protection against all sorts of injuries of which the normal working cell of the body receives?* The normal working cell is a part of the organism and is under the control and the protection of the cell community; the cancer cell is not.

The central nervous system, which is the most important factor in the protection to cell life, is not supplied to the malignant growth. Only the normal cell constituents, such as connective tissue, which often invade the tumor, may be supplied with sensory nerve fibers. The pain which is associated with carcinoma is usually felt in the surrounding structure upon which the growth impinges. This pain acts as a warning sign that the growth is trying to invade the normal structures—an alarm. The cancer proper has no sensitive nerve fibers. It may be cauterized or cut into without the patient's discomfort, providing the surrounding structures are not touched.

There is a striking resemblance in the organization of cell community life to that of the human society. Jacques Loeb calls the body a society of tissues and the organs the complex cell. He claims that death is not inherent in the individual cell but is the fate of the more complex organisms in which different types of cells or tissues are dependent upon each other.

We believe, however, that death in the individual cell is just as natural as the death of complex organs.

Not all the tissues of the body are endowed with the same resistance to injury. Their tenacity varies with their importance in the preservation of life of the organism. To the cells most essential to life on the whole is given the greatest protection.

The organization of human beings and of cells illustrates that our body is merely a composite of many individual smaller units, each contributing to the welfare of the whole, just as each citizen contributes to the welfare of the human race. How far this cooperation in cell life functions we do not know. Cells may be even better organized than the human family.

There may be in the cell organization laws governing the nutrition and protection of the segregated clusters of recalcitrant cells. If there are cell workers, cell soldiers, cell judges, then why not cell thieves and cell prisoners? And so by analogy we may consistently reason that cancer cells do not share the same privileges that the normal working cells enjoy.

CONCLUSION

(*a*) Carcinoma may be considered an enemy or a parasite of the human organism, which has less resistance than the human organism itself. (*b*) We have now, I believe, the means of destroying cancer cells without material injury to the normal cells, provided we employ the agents at our disposal in a logical manner. (*c*) The best means we now possess are radical surgery combined with a scientific application of radiotherapy. We must, however, bear in mind that the application of these methods may influence the growth in more than one way. They may destroy it, may arrest or sterilize it, and even may accelerate the growth. Therefore, the roentgenologist and the surgeon must understand that in the possession of these therapeutic agencies, they have the means of doing a great deal of good and also a great deal of harm.

A statistical report of our work is not available at present, neither is it advisable, because the majority of cases treated by the method here advocated dates back only about one or two years. We have in our series of over 200 cases, some of which have stood a long test, one being fourteen years, another nine years, without recurrence. We fully realize that a great deal can be accomplished with the roentgen rays and radium alone, without the aid of surgery, and we do not subject every case to surgical operation. But we are trying to make a comparative study as to whether surgery combined with radiotherapy will accomplish more than either of them alone. Our results have not always been satisfactory, but we are not discouraged, for the class of cases in which this apparently radical treatment is employed has very little to lose, and we are convinced that we have benefited a few and harmed none.

DISCUSSION

Dr. A. W. Crane, Kalamazoo, Mich. I think you will all agree with me that for a combination of daring and skill Dr. Beck is without an equal. I think no other surgeon in this country has dared to make so extensive an operation in case of malignant disease and to leave the entire field of operations open. The results which he has obtained certainly justify his procedure, and the addition of the roentgen ray according to his method may or may not be credited for some of his extraordinary results. There would seem to be a decided advantage in having so extensive a drainage of the field of malignancy.

The general subject of the relation of the surgeon to the roentgen operator brings up the general question of how we stand at the present time as roentgenologists in our relation to surgery. Certainly if we always worked with a man with such liberal views as Dr. Beck, so willing to undertake any operation, however formidable, in cooperation with the roentgenologist, we could perhaps have a better time of it.

At the present time when cases are referred to us for roentgen treatment either before or after operation, we must indeed pause, in view of some of the results. From my own limited experience, and especially from the experience of others that I have learned about, it would seem to be a hazardous matter for the surgeon to operate in case of malignant diseases too soon after the part has been irradiated. Within one or possibly two weeks after a thorough radiation in some cases there seems to be an especially dangerous time for the surgeon to operate. Recurrence may take place with extraordinary virulence and go to an extraordinary extent. But if we were able to administer a carcinoma dose (by which we would understand the destruction of the carcinoma cells, or the potential sterilization of that cell so it would no longer be able to undergo the process of cell division), after an interval such as thirty days, then we would seem to make cancer safe for the surgeon. As a matter of fact, the surgeon who cuts into a malignancy after it has received preliminary roentgen treatment, before a sufficient time has elapsed, is often met by a recurrence of unusual violence, when the cell certainly hasn't been destroyed and its capacity for cell division has not, apparently, been interfered with. On the contrary, it seems at times to have been stimulated. The cancer cells need to lie undisturbed for a certain period in tissues that have been radiated in order to meet fully the destructive processes set up by the roentgen ray. These processes immunizing, but otherwise strangely local.

This would bring up the subject which Dr. Knox and Dr. Pfahler, discussed last night, namely, the reaction of tissues to the cancer cells. That is certainly the important thing, just as it is in other types of roentgen treatment. For instance, the tubercle bacillus can be thoroughly irradiated and apparently its capacity to grow not interfered with, but in cases of tuberculous glands of the neck the roentgen treatment may bring about a complete cure. Apparently the only explanation of this is the reaction between the diseased tissue and the healthy tissue and fluids of the body.

Some fifteen years ago at a meeting of this Society in Cincinnati I had the temerity to read a paper entitled, "Immunity and *X*-Ray Therapeutics." I wouldn't dare do such a thing at the present time. But nevertheless it has never ceased to seem to me that some form of general immunity similar to other types of immunity must take place when the disintegrated cancer tissue is liberated within the body. There must be some kind of reaction, and if that reaction could be intelligently produced and controlled, it would solve much of our difficulty. If the problem is one of securing an immunity, how can we have team work with the surgeons? It is probably true that when we break down a lymphosarcoma of large mass, and such a vast quantity of disintegrated material is set loose in the body, we have what the immunologist would call a negative phase, and that the defenses of the body are broken down by such overwhelming toxemia. If that were true, then immediately following roentgen treatment, if the surgeon could remove a sufficient quantity of this material, possibly he might be of use notwithstanding the increased danger of metastases, but at the present time I feel that we are on the narrow edge of having to take a definite stand as to whether actually the roentgenologist can cooperate with the surgeon or whether he must consider that malignant disease must in each case either be regarded as wholly surgical or wholly a roentgenological problem.

Dr. Alden Williams, Grand Rapids, Mich. Dr. Crane, just as he sat down, made the statement that possibly we were on the borderline of deciding whether to use surgery or radiation. At least, that was what I gathered from his remarks. I think that I would hardly make quite so general a statement as that. It is very seldom that Dr. Crane's remarks are anything but conservative, and he probably meant to say that there are cases in which there could be, or should be, no cooperation, cases in which the patient should be left entirely in the hands of the radiologist, and other cases in which the radiologist should keep entirely out of it and let the surgeon make his cure, which he can do alone.

Dr. Beck started off with cooperation as his first point. That requires, almost, a definition. It would be one definition from the surgeon and another from the radiologist. On the whole, it seems that the surgeons are consulting more with the radiologists over the country, and vice versa, and I think that this cooperation is working out for good. It does seem that we are all dissatisfied at receiving a patient who has been thoroughly mutilated and being asked to give five hours' therapy. I called up one of the surgeons in our town and asked him what he meant by five hours. He said, "Damned if I know." I presume that he had read somewhere that someone had given five hours. Possibly it was five milliamperes for one hour that he meant. I asked him if he objected to my going ahead with the case as I thought best, and he said "Go on." We find out, I believe, that in going at the matter tactfully we have thorough support. Such men as Dr. Beck have helped our cause. Dr. Beck in his association with the American College of Surgeons has always backed our cause, and it is through such men, who are both radiologists and surgeons, that we are making progress.

Dr. G. E. Pfahler, Philadelphia. I apologize for appearing before you so often, but some of the discussion has aroused my interest. I feel very definitely that for the good of the individual patient, and probably for the good of cancer therapy in general, it would be a very great advantage if there could be a preliminary conference between the radiologist—I will put him first—the surgeon, and the family physician, in which all phases of the interests of the patient who has the cancer would receive the best consideration.

I feel very strongly that if we can cooperate more closely with the surgeon and the family physician we will accomplish a great deal more than we would otherwise.

I do not feel, however, that every one of these cases, or even a great percentage of them, should be cut open and laid open for our treatment. I think that that involves much risk, though in some cases it is undoubtedly beneficial. The results that Dr. Beck has shown here, and that I have seen shown repeatedly before, are very convincing that in certain cases this is a desirable thing to do, but I think those cases should be chosen most carefully. I doubt very much that it was necessary, for instance, in the lip cases that he has shown. Certainly I can show equally good results without any such procedure and accomplished by radiation, or a combination of radiation and electrocoagulation. I do feel that even in those lip cases the surgeon can be of the greatest aid in helping to fix up the patient, after he has gotten well from his cancer, by doing a plastic operation, building up a new lip, closing up the mouth, or whatever it happens to be. We certainly must, and I do, continue to call on the surgeon for those purposes, and also for this preliminary advice as to what is best to do for the individual patient.

Now Dr. Crane has made some statements with which I can not agree, and which I think we must consider very carefully. I have treated many of these patients preliminary to operation, and I believe it is one of the two best things to be considered in practically every case of malignant disease. I tell the patients this, and I tell the family physician this, and I tell you this—I believe that one of two procedures today is best, but I do not know which. I think that remains to be determined by a long observation of carefully studied cases. One is a preliminary or a preoperative course of treatment, followed by radical operation and followed again by a second course of treatment.

The second recommendation is complete treatment by radiation combining roentgen rays and radium.

Dr. Crane. How soon would you have the patient operated on after the preliminary course?

Dr. Pfahler. Approximately two weeks, or as soon as they have passed the preliminary toxic stage, whatever duration that is. It will depend somewhat upon the technique and the treatment that has been given preliminary to the operation, so that one cannot lay down definite rules—but I think the average patient can be operated upon within two or three weeks from the time that we first see the patient and start our course of treatment.

Now, then, I have never seen the slightest evidence of stimulation of the growth. I have not yet had any rapid recurrence or dissemination of the disease. I certainly should have it, if the observations that Dr. Crane has made apply everywhere. I do not believe that it occurs as a result of the radiation. It may be that Dr. Crane has seen some rapidly disseminated cases that happened to develop more rapidly just at that time—more of a coincidence than anything else—but I have not observed it; and I say now what I have not said before, but what I think ought to be said, I have never seen the stimulation of any growth by radiation at any time during my twenty-four years of radiotherapy. I have never seen, even when we worked with those minute doses, anything that suggested stimulation of the growth. In many instances the growth has gone on just about as it had progressed before, but I have not seen it stimulated. The experimental work shows, if you will follow it closely, that there is a stage when there is apparent stimulation. Dr. Mavor in his work on the fruit fly has found a certain stage in the development of these flies where there is an apparent stimulation, but as the flies go along there is always an evidence of retardation or interference with growth. This is true, practically, so far as I know, with all of the animals that have been experimented upon. So I do not believe we need expect this stimulation.

Now, then, what is the theory of this preliminary treatment? It is to devitalize the cancer cells. And why do we say they devitalize? Because of experimental work that has been done. Unfortunately I cannot give you the references, off-hand, but I think it is La Pointe who took first a series of mouse cancer that gave almost a constant or a universal take, and he exposed a tumor tissue alone in this instance. You will find these records in Colwell and Russ's book as well as in other literature. The tumor tissue was simply exposed and then inoculated, and another half-control which was not exposed gave the usual amount of takes while the tissue that was exposed to the rays either did not take, or took in a very low percentage. Now that is the theory upon which we give preoperative treatment with the thought of devitalizing the cancer cells, so that in the process of manipulation during operation, or implantation during operation these cells cannot immediately inoculate themselves in the open wound or cannot readily float into the circulation and be distributed elsewhere and grow. That is the theory of that side of it.

The other theory is just what Dr. Crane also referred to, but I think did not quite get the thought. That is, the work that has more recently been done at the Rockefeller Institute in which they exposed the field of inoculation and then inoculated and found that the growths, the tumors, would not develop.

Well, here we have the same process. We are exposing the field and then the surgeon operates and that tissue has been exposed; therefore the cancer cells should not, on that theory, at least, inoculate themselves.

I am convinced that a great deal of good has been accomplished. Just what it means in percentages it is hard to determine, because it is difficult to classify cases absolutely, but I do feel that this preoperative treatment is a thing to be considered.

Now the second line of action in the treatment of malignant disease, as I see it, is to treat the case straight through with roentgen rays, perhaps associated with radium applied locally to the tumor tissue. There is where Dr. Beck's work permits us to bring the radium particularly into direct contact with the tissue and get more intense action locally, and I think that is what he has accomplished by getting his radium rather than the roentgen rays in direct contact with the tumor tissue.

Dr. Wm. A. Evans, Detroit. I would like to defend Dr. Crane's stand. I heard from him that he had an experience lately regarding a case of recurrence. We have had two recently. Dr. Christie had others, and I believe there is a real danger in operating shortly following a deep exposure over a cancerous breast. I believe from reading and from observation, that cancer is not a local disease, even in the early stages, since it is proven pathologically that in an early cancer of the breast you will find cancer cells all over the body: they are in the blood vessels, the heart, lungs, and other parts of the body. The cells are under various stages of degeneration, and you do not remove the disease when you remove the local tumor. I think there is a real danger in operating too soon following deep therapy over a cancerous breast. I will say four weeks is the limit in our experience. We had one with a recurrence in three weeks, that is, operation three weeks following the treatment, and another recurrence in four weeks.

Dr. Crane. Ours was two weeks, or between two and three weeks.

Dr. Evans. I think there is a real danger there. I think it is a further proof that the disease is not local and there is a question of immunity that is interfered with both by surgery and by deep radiation.

Dr. Gray. Possibly Dr. Evans is creating a wrong impression when he says from his observations and reading that cancer is never a local disease. He says that there are cells in the heart and elsewhere. I wonder if he does not mean that there *may* be. If it is never a local disease, then every case of carcinoma of the breast that has been operated on has been a mistaken diagnosis if the case has been cured. I grant you that we may have dissemination of cancer cells when there is the slightest appearance of a primary growth, but I could never convince myself in the world that all of the cures for years and years by the surgeons by the removal of the breast were on faulty diagnoses.

Dr. Robert Knox, London. Of course the proper discussion of a question of this kind would involve a very considerable amount of time. I could deal with one or two aspects of the paper.

To begin with, I agree with what Dr. Beck said at the beginning, that the question of the cure of cancer would never be settled by either surgery or radiation. I think when a cure is found it will be on lines of immunity, and whether we by our radiations induce a degree of immunity or not is not quite proved. I think we do to some extent. The question of the immunity production in the patients has been worked out at the Middlesex Hospital by surgeons and radiologists in collaboration. The technique, I think, was described by Professor Russ when in America on a recent visit. In inoperable cases of carcinoma a portion of the breast, a portion of the active tumor, is removed and treated to what Professor Russ calls a lethal dose of radiations. After the tissue has been thoroughly irradiated, it is inserted into the abdominal wall by the surgeon and in this way an attempt is made to immunize the patient. We have not had time to determine yet whether any beneficial result has followed from that treatment or not, but Professor Russ is very emphatic on this point when he states that in none of the cases so treated has there ever been local recurrence, a local manifestation of the cancer. Well, that is a very emphatic statement. I do not think it means very much, because the patient as a rule has been an advanced case of carcinoma, and is perhaps pretty well immunized by the cancer itself, so I do not think we can pay very much attention to that.

As far as the results go, some patients improve, and ultimately most of them die. But Mr. Sampson Haendly made one very important observation in discussing the matter with me. I have treated several cases which have been immunized in this way, with the *x*-ray treatment, and Mr. Haendly made the very significant observation that he had not found any benefit from the immunity process, but 1 or 2 cases, perhaps 3 or 4 cases, which had suppurated, had improved considerably as a result of the suppuration. Now that was a streptococcal infection of the wound and an abscess formation, and after the abscess cleared up the patient made fairly satisfactory progress, and I believe Mr. Haendly is now trying inoculations with streptococcal infections, in the hope that he will stimulate reactive processes in the patient.

In regard to stimulation by *x*-rays, I think it does undoubtedly occur. I have met with cases which have, after *x*-ray treatment, shown an alarming spread, which could not quite be explained by a natural extension of the growth. I think we have to reckon with it as a possible thing, and I think it is logical to assume that it is a possible thing, too, because an agent which is supposed to be so powerful for good must sometimes do some harm.

In regard to the preoperative treatment, I am entirely in favor of it if there is time. That is, if for any reason the patient cannot be operated upon at once, I give preoperative treatment; but I don't think I would be inclined to wait much longer than a month before suggesting that the operation should be done. I don't think we ought to delay in the hope that any effect we are going to get from the radiations is likely to be of much value. I think it is much more important to get the primary tumor removed and to continue the postoperative treatment as thoroughly as possible.

Now in London the gynecologists have been using radium in cervical carcinoma, and several gynecologists say they prefer to give a radium exposure—a good, strong, lengthy radium exposure prior to operation, then wait about one month or six weeks. Several surgeons who have carried out this technique say that the operation is rendered very much easier, and they find a great advantage from the preoperative treatment by radium.

I have treated several of these cases afterwards by *x*-rays to affect the glands as much as possible, and these patients have done extremely well. So from the point of view of radium, preoperative treatment in conditions of that kind is to be advised.

I am heartily in sympathy with any effort which means an attempt at collaboration between the surgeons and the radiologists. We can help one another, we have helped one another.

As far as we in England are concerned, I can assure you that the sympathy is genuine, and the cooperation is very effective.

Dr. Beck (closing). I will answer some of the questions.

The one asked by Dr. Crane: "How do we stand with the surgeons?" I think you stand very well with the surgeons, very much better than years ago. I am sorry to say, however, that sometimes, even now, surgeons will say: "There isn't anything in it." I heard a prominent surgeon state in a meeting of roentgenologists as large as this, that he had never seen a case of cancer cured by radiology and that he had seen many of them made worse; but that he had seen many cases cured by surgery. Such pessimism is rare. As I watch the surgical profession and their attitude, I see that year by year they have gained more and more confidence in radiology, especially if combined with surgery. If radiologists do not make too extravagant claims, I am sure they will find very helpful cooperation from surgeons.

I think the idea of Dr. Pfahler is a very good one. Surgeons, physicians and radiologists should come together and discuss their problems. I have learned a great deal in these meetings, and, therefore, I am not skeptical, although I used to be. Dr. Pfahler got the wrong impression if he thought that every case that comes to us with cancer is subjected to this kind of an operation. We have an efficient department for radiology, where we treat most of the cases without surgery. There are many cases, however, such as carcinoma of the prostate gland, upon which we no longer attempt to operate.

So far as the preoperative radiation is concerned, I know now a great deal less than I did before. Some of you gentlemen say it shouldn't be done, and others say it should be. I will have to decide then for myself.

PROBLEM OF DEEP THERAPY*

BY GUSTAV BUCKY, M.D.

BERLIN, GERMANY

No one will claim that the problems of deep therapy have already been solved. Since this is so, it is often very helpful to make a critical survey of the predominant points of view, even if we are not able to answer all questions satisfactorily or to point the way that must be traversed.

Before we proceed further, it is necessary to recognize one fact as essential—that for the study and practice of this therapy, an absolutely accurate measurement is indispensable.

Several fundamental reasons for present-day views and for the technique of rays should receive close examination.

By far the most important point is the assumption that the effect of the roentgen rays depends on the quantity, not the quality, of the absorbed rays. But if we review the literature, we cannot escape the impression that there is no absolute proof of this assumption, since the biological experiments, as well as the clinical treatment, have always been made either with heterogeneous rays or with only the hardest part of the roentgen-ray spectrum. Indisputable experiments with moderately hard homogeneous rays failed because of the impossibility of producing these rays in the necessary quantity. Probably the time has now come when the advancement of the measurement technique enables us to make such investigations.

But if we want to assume from the foregoing that as a matter of fact only the absorbed quantity causes the effect, we cannot then explain how it was possible to get results at all in the past. For instance, we cured myoma with soft and almost unfiltered rays. If we compare the doses in the depth *then* with those of today, we will see that we had only a fraction of the quantity which is today assumed to be necessary for result. But if the quantity was insufficient and nevertheless the result was apparent, then one easily concludes that the explanation may be found in the quality of the rays. It is also remarkable that the roentgen disease, the so-called "Rontgenkater," increases with the hardness of the rays. Let us assume that we irradiate two almost similar myomas with the result that in both cases an amenorrhea is reached. Each patient should be treated with different quality of rays. Then we will see that the one treated with the hard rays will show more severe symptoms of roentgen sickness than the one treated with softer rays; and this, in spite of all precautions in regard to ventilation, etc. Even if we examine our patients in general and compare the recent cases with those treated in former years, the large increase of roentgen sickness is evident. Every expert will bear this out. One can reply to this that only the increased dose in the depth with resultant decay of the pathological tissue and absorption, is responsible for the greater roentgen sickness. This is not so, because the decay of the pathological tissue certainly takes place later than the appearance of the roentgen-sickness. Nobody will assume that in case of myoma treatment, the myoma or the ovaries immediately begin to disintegrate. On the contrary, the ovaries often function after four weeks and, in most cases, at least one menstruation takes place after irradiation. The reason for the more severe sickness, therefore, is to be found in the harder quality of the rays as they attack the healthy tissue more forcibly. This is proved also, by the blood picture.

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* Read at the Twenty-fourth Annual Meeting of The American Roentgen Ray Society, Chicago, Ill., Sept. 18–21, 1923.

Therefore, we cannot deny that probably the length of the waves is a very important factor in the result, and that very probably there exists a specific effect due to the quality of the rays. We have these differences in quality with other rays, therefore why not here? It is of fundamental importance to take up this question again since we now have ways and means to solve it.

Another principle of our present-day method is that a definite quantity of rays (absorbed dose) always has the same effect on a certain organ or tissue, so-called carcinoma dose, castration dose, etc. Now, everywhere in medicine we find that the effect of all our therapeutics depends on the most varied factors—individual predisposition, tolerance, idiosyncrasy, the general condition of the body, etc. It is more than likely that this holds true for roentgen rays also, because we know that different individuals, in spite of the same dose, get roentgen sickness of different intensities. It is also observed that upon repetition of the treatment there may occur more severe roentgen sickness after each treatment. It has also been noticed that roentgen treatment of carcinoma in cachectic patients often produces no reaction in the carcinoma. In all these examples we see the various effects of similar doses. Is it at all permissible under these circumstances to fix definite doses regardless of the well-known varied sensibility of tumors of the same type?

It is more or less assumed that the cure of tumors is brought about by the direct destruction of the pathological cells by the roentgen rays. Therefore the largest possible doses are considered the most effective, and endeavor is made to increase the doses in the depth by all possible means. Is this assumption correct? It is known that one can irradiate a dead tissue indefinitely without noticing any change or destruction. But since it is established that changes of the tissue in the living body are noticeable, we can conclude that the roentgen rays act on the function of the cells. Through changes in the atom structure, metabolism or what not, the cell is devitalized or destroyed. But if the pathological cell disappears, it must be replaced by a healthy cell. There is a continuous struggle between the normal and the pathological cell, and the stronger is the victor. The cure depends, therefore, on the fact that the healthy cells win out, not because the rays destroy the pathological cells, but because they weaken them and thereby assist the healthy cells. The battle is carried on by the cell. In other words, the tumor with its tendency to spread, moves centrifugally from its source and strives to invade the surrounding structures. The surrounding tissue, however, strives to drive out the enemy which threatens it with death, and tries to take its place. That means that the surrounding tissue moves centripetally to the source of the tumor. Depending upon which is the stronger, the result is either destruction and spreading out, or recovery.

We learn from this that we ought to weaken the pathological cells without affecting in the least the surrounding healthy cells. Our aim, therefore, should be to give such a dose as will retard the pathological cell without attacking the healthy tissue to an appreciable degree. It appears desirable, therefore, to make the dose dependent on the influence on the healthy cells in the neighborhood of the pathological cells. That seems to be the right goal. The skin evidences cannot be taken as a guide because it gives us no information about what is going on in the deeper tissue layers.

One, therefore, comes to doubt if the large deep doses are at all advisable as they are measured by the physicists. For similar reasons it seems very problematical if we are justified in increasing the deep dose in any way. You know that above all we use the very hard rays for increasing the deep dose. In proportion as the hardness of the rays increases, so do the scattered rays, and along with them the physically measured deep dose. The scattered rays spread in all directions so that much more healthy tissue is penetrated in the region of the cone of primary rays than would be the case with softer rays. The consequence of this is that the healthy cells are more strongly affected and are weakened. We therefore get a result which seems, according to the considerations above, not to be desired, since the defensive strength of the healthy against the pathological tissue is weakened.

Finally, let us call attention to the so-called "reiz dosen" (stimulation doses). It is claimed that small quantities of rays stimulate the growth of the tissue and that it is therefore dangerous to give small doses in malignant tumors. Holzknecht has found in the entire literature only 2 cases where small doses have caused such irritation. Furthermore, we have given, in previous times, proportionally small doses as compared with those given at present, without any appearance of stimulation. Haenisch reports 1 case of sarcoma of the neck in which he gave a large dose which led to an acute compression of the trachea two days after raying. Petry rayed lilac buds with very large doses and observed a quick and rapid development of the flowers, followed, however, by a speedy death. This indicates that stimulation results also from large, and even maximum doses. In these cases there appears to be a more rapid growth than after small doses, but quick destruction follows. The existence of so-called "reiz dosen" is at least doubtful if you expect to produce it only by small quantities of rays. In every case the danger of stimulation is greater with large than with small doses. You will hardly be able to support the demand for large doses.

These considerations lead to the following conclusions:

1. The right to establish a standard tissue-dose or organ-dose (so-called mathematical or physical doses) applicable in every case, is decidedly doubtful. More than that, it appears advisable to give the dose according to the appearance of the healthy cells which surround the organ to be treated.

2. Over-large doses, even if they show only slight skin symptoms, do not seem to be advisable. Just as little is it advisable to grade the dose according to the skin appearances.

3. The use of extremely hard rays seems to be inadvisable.

4. During treatment much attention should be given to the general appearance and state of health.

5. Special consideration should be given to biological in addition to physical research, particularly to clear up the very important question of the connection of the wave-length with biological effect.

These conclusions contain a program of research. It would be in the interest of humanity to find ways and means to solve them.

DISCUSSION

R. T. LEUCUTIA, Detroit. My discussion is directed especially to Dr. Bucky's paper and the point I desire to consider is the question of dosage in deep roentgen therapy, as practiced at the present time.

During the past two days, the opinion has been expressed at this meeting that the "massive dose" treatment has passed its time and in consequence the administration of more moderate, so-called "fractional doses" has been advocated. On the other hand, we have presented this morning a number of cases illustrating complete eradication of the disease where massive doses have been used. I should like to try to get these two methods of treatment in harmony and to find some basis which will explain the use of both of these apparently opposed methods.

Dr. Knox, in a very brilliant paper last night, arrived at some important conclusions with regard to the action of roentgen rays on pathological cells. He was of the opinion that the more undifferentiated the cells are, and the more atypical their mitosis, the more sensitive they are to radiation; consequently, the better the results to be expected. However, in addition to this primary action of the roentgen ray on the tumor cells, there is another process to be considered, namely, the secondary action produced by the reaction from the site of the irradiated normal tissues surrounding the tumor mass. This secondary action is certainly of no less importance than the primary action on the cells.

Dr. Bucky, in his paper, expressed the same opinion in another way. He talks of a centripetal and centrifugal action which exists between the tumor and the surrounding tissues, and he thinks that our aim should be to stimulate the centripetal action of the surrounding tissues rather than to destroy the centrifugal action of the tumor itself. In consequence, he advocates the administration of moderate doses repeated at shorter intervals.

In our cases, brought to your attention this morning, you certainly have observed that by administering the massive dose, the best results were obtained in tumors of the *embryonal* type, which are rich in cellular structures, while the tumors of the *adult* type, especially those rich in paraplastic structures have shown only little or no response to the massive radiation. The reason for this, I believe, lies in the fact that when treating a tumor of the embryonal type the highest dose required for the destruction of the cells forming the tumor mass (90 per cent S. E. D.) is lower than the dose which would destroy the normal cells surrounding the tumor. In the case of a tumor rich in paraplastic structures, the dose required for the destruction of the growth would be so high that it would damage normal tissue before having any effect on the pathological tissues themselves. Indeed, it seems that in tumors of the embryonal type, the massive dose tending to destroy the lesion and consequently to eradicate the disease in as short time as possible is the method to be chosen; while in adult tumors, or growth near to the adult type, a dose stimulating the action of normal tissues surrounding the tumor is rather to be preferred. These latter are the tumors where the fractional doses, repeated at shorter intervals—as mentioned so often during the past two days—will give more satisfactory results. Of course, between these two extremes, there are a number of intermediate tumors in which both methods may give good results, or may fail. These tumors will always form a large field for future investigations and discussions.

I should like to point out to you that when we talk of a "massive dose" we do not mean the concentrated massive dose, administered in one sitting, as it is practiced in Germany, but the divided (non-concentrated) massive dose; that is, a massive dose spread over a period of several days, according to the tolerance limit of the patient. As you see, this technique—in opposition to the technique of the fractional dose, where moderate exposures are repeated at shorter or longer intervals—tries also to administer the dose in as short a time as possible, but pays more attention to the general reaction and gives the patient ample time to recover from the ill effects of the individual treatments. However, rarely is the treatment spread over a period longer than one week, except in cases of generalized, systemic diseases such as lymphosarcoma, Hodgkin's disease, lymphatic leucemia, etc., where numerous exposures (even fifteen to twenty areas) are necessary.

The administration of the massive dose, as described above, has also, I believe, another advantage; namely, that it stimulates a general reaction of the defense mechanism of the body. We do not, as yet, know anything about sarcoma or carcinoma immunity, so it would be too far-reaching to enter into theoretical discussions regarding this problem. However, in our cases mentioned this morning, there was an angiosarcoma of the iliac bone producing extensive metastases to the lungs, which, after a massive dose treatment of both the pelvis and the lungs, not only completely disappeared for a period of over a year, but has shown no signs of metastasis in any other part of the body. Indeed, it is hard to imagine that the metastatic sarcoma cells have lodged only in the lungs without being carried by the blood stream to other organs of the body; and still the patient has remained free from metastasis. Another example: In lymphosarcomata, we treated at the beginning only the local manifestation and the evident metastases; but shortly following the treatment other metastases appeared which did not respond to further radiation, and the patients died. At the present time, we treat right from the beginning the whole lymphatic system, giving heroic doses (as many as fifteen to twenty exposures) and the results are striking; all our patients remained alive for a period of over a year and a half. It seems, indeed, that following the administration of such heavy doses, formation of some kind of antibodies is stimulated, which help to kill or encapsulate individual cells circulating in the blood stream or already lodged in other organs of the body not exposed to radiation. It may be that this is not an immunity process in the perfect sense of the word, but it is certain that something happened which is very near to that immunity. Future investigations will show what this is and whether it really deserves the importance predicted at the present time.

THE DIAGNOSIS AND TREATMENT OF ENLARGED THYMUS*

BY G. W. GRIER, M.D.

PITTSBURGH, PENNSYLVANIA

THE object of this paper is to call attention to the comparative frequency of enlarged thymus, to state some observations in diagnosis and to discuss our experience in the treatment of this condition with radium. My remarks will refer chiefly to new-born babies or young infants. Undoubtedly, many backward babies suffer from this condition, unrecognized, and probably not a few of the deaths in infants occurring during the first few days of life are due to this cause. I have recently seen 2 cases where new-born babies living but a few hours were roentgenographed post-mortem for possible cause of death, and marked enlargement of the thymus found in each.

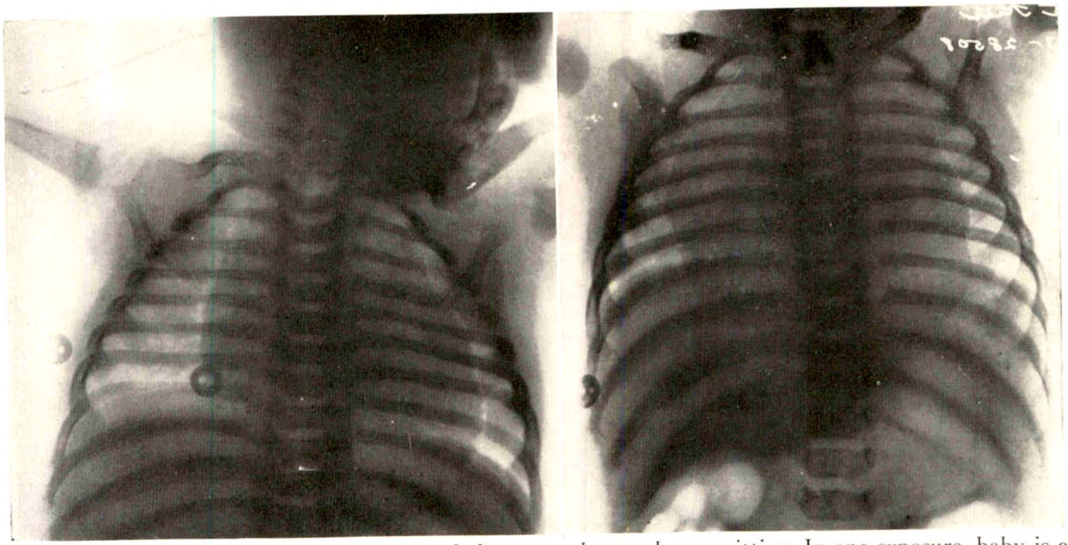

FIG. 1. Enlarged thymus. Two exposures, same baby, same date and same sitting. In one exposure, baby is crying and in the other it is quiet.

At the Magee Maternity Hospital, Pittsburgh, during the last year and a half, the Roentgen Department has diagnosed 18 cases of enlarged thymus in new-born babies. During this time there have been 2,700 deliveries. In the last two years we have seen 12 cases in our private laboratory and certainly as many more in our roentgen services at the Passavant, Presbyterian and St. John's Hospitals. The average roentgenologist then, sees a fair number of these cases, and in the majority of them, the final diagnosis and the treatment rest in his hands. This is an unusual responsibility for a roentgenologist to assume and it therefore behooves him to keep himself thoroughly familiar with this subject. If, then, I have little new to offer, I hope I will be pardoned the repetition of facts already known, since occasional discussion will keep our minds fresh on the subject. Probably the outstanding clinical sign is dyspnea of varying severity, sometimes very slight and accompanied by a peculiar crowing inspiration when the baby cries. This so-called thymic stridor, I believe, is the one characteristic sign. Dyspnea and cyanosis may or may not be present, depending upon the extent of the enlargement. If the condition goes unrecognized, the baby will be undernourished, weak and puny, pasty in color, probably with the sniffles and prone to take colds. However, none of these symptoms are pathognomonic, and the final diagnosis rests on the roentgenogram. Several of our cases have been premature babies, and I believe it would be wise to make a roentgenogram of all premature infants in order to see if this condition is present.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

The roentgen appearance of the thymus shadow has been well described by Lange, Heublein and others. I will not take the time to repeat this description except to call attention to the fact that the thymus shadow usually extends on both sides of the spine and that the lateral borders are convex or bulging, and not concave, as is usually seen in tuberculous adentitis of the superior mediastinum. Also, that the shadow is wider below where it merges with the base of the heart than it is above at the base of the neck. Probably the main point of differentiation between the thymus shadow and other masses in the mediastinum which might be confused with it, is that the thymus shadow is more or less symmetrical on both sides and that it is wider below than above. It fits down over the base of the heart like a cap on one's head. The thymus shadow increases remarkably in size when the baby cries, and it is chiefly to call attention to this fact that this paper is presented. The significance of this fact is twofold: (1) If the enlargement is only moderate, it it may not be recognized unless the baby is allowed to cry during the exposure; (2) plates made during the course of treatment to note reduction in size are only comparable when made with the infant in the same state; that is, crying or quiet. If possible, it is interesting to have an exposure both ways at each examination.

The enlargement, when the baby cries, is, I believe, due to two causes: (1) An engorgement of the gland with blood as a part of the general congestion of the blood vessels above the diaphragm; (2) the elevation of the diaphragm incident to the forced expiration during crying. The latter, I believe, is the more important of the two because it lifts the heart up and consequently the thymus lying above the heart; and as it is lifted up it spreads out on each side. The fact that the diaphragm is higher during crying is easily demonstrated by comparing its level upon the ribs with that when quiet. Since it is impossible to control the actions of an infant the exposures, of course, must be practically instantaneous; that is, in one-tenth of a second or less. This is particularly true if the baby is crying. Fortunately, this is entirely possible with all makes of up-to-date apparatus. If a record is not kept of the fact as to whether the baby is crying or quiet during the exposure, the same end may be arrived at by noting the level of the diaphragm in comparison with the ribs. Plates made at different

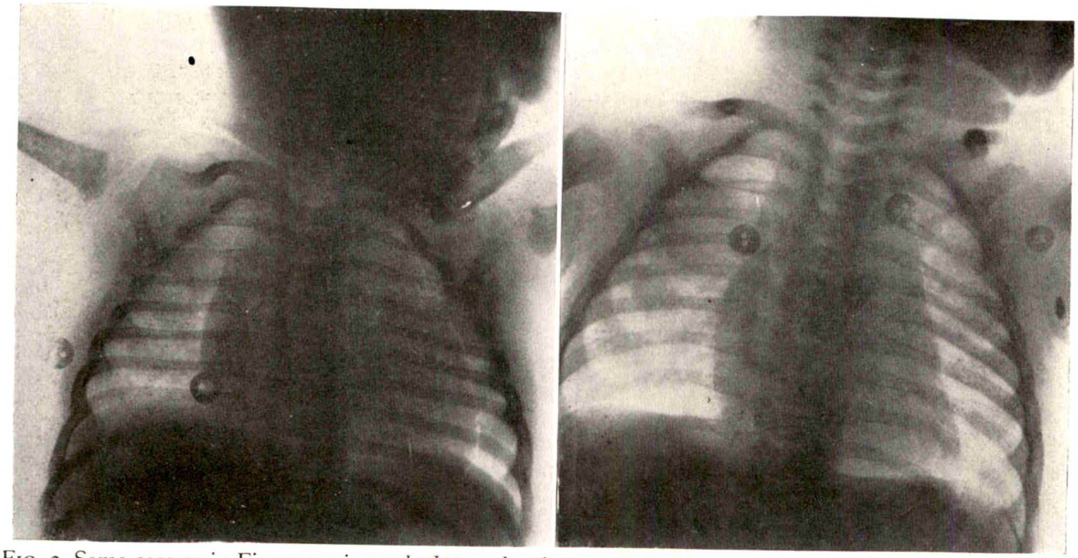

FIG. 2. Same case as in Figure 1; six weeks later, showing result of treatment. Baby quiet at both exposures.

times are only comparable when the diaphragm is level with the same rib. For instance, with the baby quiet the right diaphragm may be on a level with the ninth rib and when it cries it will ascend to the level of the seventh rib. The shadow of the thymus in the second plate will be much wider than in the first, due to the shortening of the chest. This must be taken into account when considering the result of treatment, since if the first plate is made with the baby crying and the plate after treatment with the baby quiet, the reduction in size will appear to be greater than it really is, and vice versa.

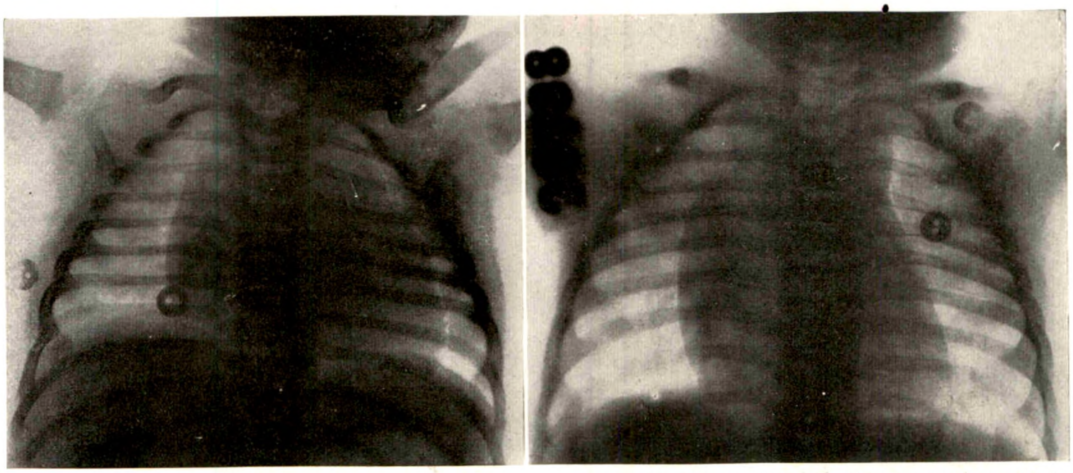

FIG. 3. Same case as in Figure 1, showing view before treatment with baby quiet and after treatment with baby crying, giving an unfavorable idea as to result of treatment.

Treatment: There are few instances in medicine where the introduction of a new method of treatment has produced such remarkable improvement in results as in roentgenotherapy of enlarged thymus. Before the roentgen era, practically the only treatment was surgical removal. The operation is a serious one, and the percentage of recoveries very low. It is true that the condition is not necessarily fatal if untreated, but the mortality under such circumstances is certainly very high Under roentgenotherapy, the percentage of complete cures is correspondingly high, and if the condition is discovered early and treated promptly, the danger of a thymic death is remote.

While the results from the use of roentgen rays are very satisfactory, I have abandoned this treatment in favor of radium, mainly for two reasons: (1) Quicker response to treatment, (2) greater ease and safety of application.

While it may be possible to give a sufficiently large dose of roentgen rays at one treatment to produce the same rapid response as from radium, we have never been fortunate enough to see this. Usually two or three roentgen treatments are necessary to produce any noticeable diminution in size, and to give these requires from four to six weeks. The effect from one radium treatment is apparent in a few days. The difficulties in administering roentgen treatment to a small baby are also considerable. The baby must be held by other persons who run the risk of exposure to high voltage currents and to the roentgen-ray beam in their efforts to keep the patient still and in the proper position. Lead masks placed to expose the thymus area are apt to slip, and thus cause the treatment to be administered where it will do no good. And above all, the efforts at restraint practiced on the baby produce violent paroxysms of crying which may be dangerous, in that they increase the size of the thymus and may superinduce strangulation.

Compare with this the application of radium, placed and retained in exactly the location desired without producing any alarm or discomfort to the patient and with superior results, and no one who has ever tried both methods will hesitate in his choice. The dosage of radium required to produce a favorable result is not large. I am confident that the thymus can be sufficiently reduced in size without producing even an erythema of the skin. There are undoubtedly many minor differences in technique among radium therapists which do not alter materially the final result. However, if one follows the technique of another, he should adhere to it strictly in all respects. The main factors governing dosage are the quantity of radium used, its distribution, whether in one or several capsules, the distance from the skin and the number of areas treated. One hundred mg. of radium in one capsule and moved about over different areas has a different effect from the same quantity divided into four capsules of 25 mg. each and scattered about over one area, even if the same distance from the skin and the same number of milligram hours are used. It should be remembered that where adjoining areas are exposed, each area receives a part of a dose when the adjacent area is exposed. In an ordinary sized area of about 1 × 2 in. this extra dosage amounts to about one-quarter of the dose applied to each area, so that if four adjoining areas are treated, each area receives exactly twice the dose directly applied to it.

The technique which I have used satisfactorily for some time is to place four tubes of radium, each containing 25 mg., in a wooden block with holes bored in it 1 in. apart to contain the capsules. The filter used is 1 mm. of brass. The block is left in position for ten hours with the radium at a distance of three-fourths of an inch from the skin. This dose does not produce an erythema, and usually one treatment is all that is necessary, although occasionally it has to be repeated. It is an entirely safe dose and can be increased to twelve or fourteen hours if desired, although I have not considered it necessary.

A point that I wish to emphasize strongly is that the radium must be kept at the selected skin distance, or the dosage is entirely different from what is intended, and very small changes in this distance make considerable differences in dosage. For instance if the maximum dosage at three-fourths of an inch is fourteen hours, the maximum dosage at five-eighths of an inch is ten hours, and it is impossible for one to guess the difference between three-fourths of an inch distance and five-eighths of an inch. This distance must be carefully measured and the applicator used must be rigid, so as to maintain it constantly. The practice occasionally followed of rolling the radium up in a piece of gauze for an applicator is a dangerous one and cannot be condemned too strongly. It is important that the radium applicator should be covered on the upper surface

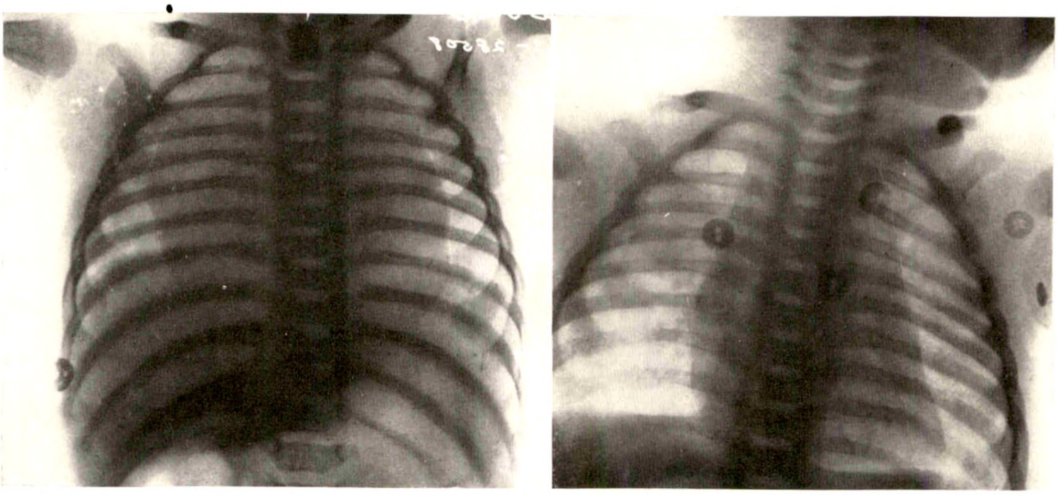

FIG. 4. Same case as in Figure 1, showing view before treatment with baby crying and after treatment with baby still. Decrease in size is apparently greater than it really is.

with lead because it comes high up under the baby's chin and is apt to produce a burn at that place unless this precaution is taken.

SUMMARY

1. One should be on the alert for enlarged thymus in young infants, especially in those of premature birth.
2. Heavy breathing, a crowing inspiration and later on a failure to thrive, should direct one's suspicions to this condition.
3. The thymus enlarges greatly when the baby cries.
4. Radium treatment is practically a specific.
5. The technique of the radium application should be carried out carefully and accurately.

DISCUSSION

Dr. L. T. LeWald, New York. In regard to Dr. Grier's paper I think we must distinguish between the function of the thymus and its secretion, and its size. He brought out the point that in some of these cases the gland still remained large roentgenographically and still the child was relieved of all symptoms. I showed in some roentgenograms at the lantern slide exhibit, twins who were perfectly well, but the thymus gland was enlarged in each one.

Dr. G. W. Holmes, Boston. May I take the time to say just a word? I think that Dr. Grier's calling attention to the necessity of making a record as to whether or not the child is crying, in other words, the influence of crying on these findings, is a very important one—a fact which has not been brought out so much as it should be.

There is one other point that I hoped he would bring out, and that is the degree of variation found in normals. The thorax of the child is very flexible, and during inspiration and expiration, even though the child is not crying, there is a considerable difference in the intrathoracic pressure and in the supracardiac shadow. The structures that go to make up the shadow include not only the thymus but the great veins, and engorgement of the great veins may simulate very closely the shadow of the thymus. I simply call attention to this fact and I wish Dr. Grier would tell us what have been his observations.

Dr. W. M. Doughty, Cincinnati. About twelve or fourteen years ago I happened to be present during the experiments of Dr. Lange on rabbits.

We are still trying to get our films of the thymus with the child quiet. It is essential to have the child perfectly straight upon the film, and pass the center ray through the center of the thymus, otherwise the smaller enlargements may not be shown.

We use the roentgen-ray treatments as they can be given in four or five minutes, giving two treatments within an interval of ten days. Ten days after the second treatment we made a film, and if there is an appreciable enlargement remaining or definite symptoms still present, we give a third treatment.

In cases of extremely small enlargement, but definite symptoms, we follow the dictum of Dr. Forcheimer, and give the therapeutic test. Many of these cases will clear up following treatments, even though definite enlargement of the gland was not present.

Dr. H. J. Ullman, Santa Barbara, Calif. Dr. Grier said that one obtained quicker results from the use of radium than from the roentgen ray.

At the Children's Memorial Hospital here in Chicago we rayed a number of thymuses at intervals, and the report usually was that the dyspnea and stridor occurring at night would be relieved the same night that the treatment was given.

I would like to ask Dr. Grier how soon he can repeat the radium dosage that he uses.

Dr. Grier (closing). I did not mean to make any reflections against roentgen-ray treatment of the thymus. I am sure it is perfectly satisfactory. I have been using it myself for years. I simply wanted to call attention to the fact that where radium and the roentgen ray were both available the radium was a much more satisfactory method of treatment, and I believe somewhat superior.

In regard to Dr. Doughty's remarks: I think that if I had only one exposure with the baby either crying or quiet, I would rather the baby should be crying because then I would know that we would not miss those cases in which the enlargement was only slight.

To discuss Dr. Holmes' remarks: I have not seen anything that we thought could be confused with a thymus shadow in the superior mediastinum. I do not believe this plays a very large part and I do not believe it is very often a source of error. The point that I wanted to make is that there is a big difference between the size of the thymus when the baby cries and when it is quiet, and unless you take this into account you may not recognize what the size of the thymus is.

The radium dose could be repeated in six weeks, although I have not repeated it inside of three months, because I wanted to give plenty of time for the thymus to decrease in size. I rather suspect what has been mentioned here a couple of times, that the baby has been relieved without a complete return of the size of the thymus to normal. Therefore, we have not repeated inside of three months, and many times not at all.

THE GENERALIZED TYPE OF OSTEITIS FIBROSA CYSTICA—VON RECKLINGHAUSEN'S DISEASE*

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INTRODUCTORY

THE localized form of osteitis fibrosa cystica occurs rather frequently and numerous cases have been reported in the literature. The generalized form, however, is of rare occurrence and since von Recklinghausen's classical description of the disease in 1891, only a few sporadic cases have been added to medical literature.

The disease was first described by Hirschberg in 1886, who regarded the condition as a form of osteomalacia. Five years later (1891) von Recklinghausen reported 3 cases and concluded that the disease was a separate entity, which he designated as osteitis fibrosa cystica. Previous to the articles of Hirschberg and von Recklinghausen, typical cases with cysts and osteomalacia were reported by Froriep in 1840, Engel in 1864, and Langendorf and Mommsen in 1875. These are now classified as belonging to the von Recklinghausen type of osteitis fibrosa.

The total number of cases reported since von Recklinghausen's original contribution is still very small. Lotsch, in 1915, reviewed the literature and found reports of 37 cases, and Roth, in 1920, found only 40. Morton's article is the most extensive publication of the disease in the American literature. He gives a complete review of the reported cases and classifies 63 cases as belonging to the generalized type, including the report of a case seen by Lovett. Bloodgood, Myerding, Barrie, Young and Cooperman have also furnished valuable contributions to the American literature. Bloodgood in numerous publications, describes both the generalized and localized types of the disease.

REPORT OF CASES

The two following cases are reported, first, because of the rarity of the disease, especially in the United States; and second to show the characteristic roentgenographic appearance of the diseased bones.

Case I. A school girl, aged fourteen, white; presented herself for examination in April, 1920, because of deformity of the left wrist, shoulder and back. Most of the history was obtained from the girl's mother.

Family History. The family history was essentially negative. Father living, aged sixty-nine, had had apoplexy. Mother living, aged fifty-four, health good. Patient is youngest of eight children.

Past History. She had had no illnesses, except measles, chicken-pox and whooping-cough. When a few months old, deformity of the left wrist was noted and as she grew it was noticed that the left forearm was shorter than the right. She was born with a lower incisor tooth erupted and at three weeks an upper incisor tooth appeared. She has never been so robust as the other children of the family. At the age of five she began to complain of aching in the joints, especially the knees. This was worse at night, often keeping her awake. She has complained of vague rheumatic joint pains most of her life, although not severe enough to prevent her from taking an active part with other children in play or work. She has never had tonsillitis or frequent colds, but has always been constipated and frequently takes a laxative. Appetite has always been poor. Does not care for milk, eggs or cereals of any kind. Eats very few vegetables; cares mostly for fruit, crab meat or steak. Sleeps well and dreams but little. She has never menstruated. Mother menstruated at age of sixteen and two sisters at age of fourteen and fifteen.

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*Thesis for membership in THE AMERICAN ROENTGEN RAY SOCIETY, 1923.

In April, 1920, first noticed crooked back. For past year there has been much less pain in the joints. Recently she has had infrequent headaches at night. In June, 1921, she fractured her right forearm while skating. This was kept in splint three months.

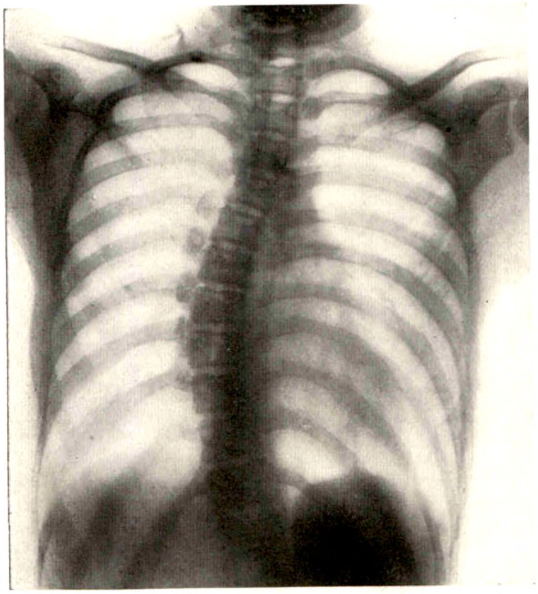

Fig. 1. Case I. Roentgenogram of the chest showing curvature of the spine and fibrocystic areas involving the vertebral ends of the ribs. Note elongation of the transverse processes of the seventh cervical vertebra.

Patient is active, runs, and is not incapacitated in any way; has attended school regularly and is now entering the first year in high school.

Physical Examination. April, 1920. Height 54 in., weight 72 lbs.; temperature 98.6; pulse 74; blood pressure 118/75. Fairly well-nourished young blonde girl with a rather marked right lateral spinal curvature, and drooping of the left shoulder which appears to be smaller than the right side. The left forearm is 1 in. shorter than the right, and the radius and ulna appear bulbous at the distal extremities. The ulna is distinctly shorter than the radius. The wrist joint movements are unimpaired.

No abnormalities noted in the head. Pupils equal and react to light and accommodation. Eye grounds normal, no exophthalmus, extra-ocular movements normal. No palpable lymph-nodes. Tonsils appear to be negative. Chest asymmetrical, due to scoliosis. Breasts undeveloped. Lungs clear. Heart not enlarged; sounds of good quality. Liver and spleen not felt. Abdomen and extremities in general negative. All tendon reflexes active. Sensation was normal throughout.

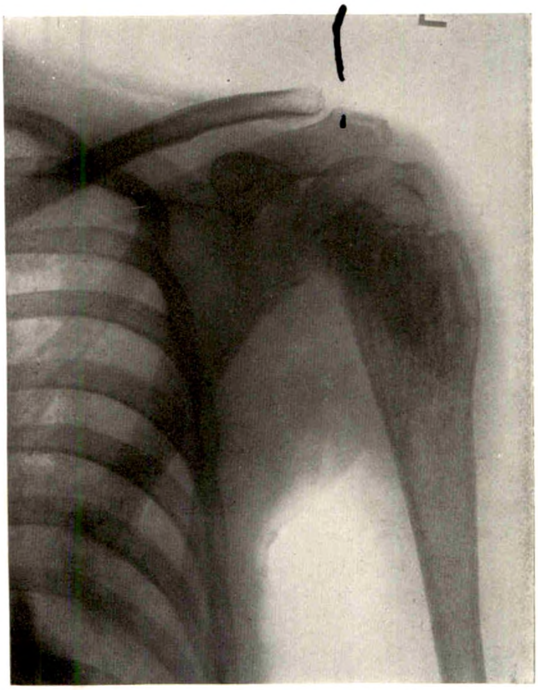

Fig. 2. Case I. Osteitis fibrosa cystica involving the diaphyseal end of the left humerus. The epiphysis and periosteum are normal.

Roentgen examination, April, 1920. Roentgenograms were made of every bone in the body. The bones of the skull were normal. The sinuses, teeth and bones of the face showed no abnormalities. The cervical vertebrae were normal except for bilateral elongation of the transverse processes of the seventh (Fig. 1). The lungs were negative. There was a pronounced curvature to the right of the mid-dorsal vertebrae. There were eleven normally developed ribs, the twelfth ribs being rudimentary. The vertebral ends of the ribs (Fig. 1) showed an expansion of the cortex, with longitudinal strands or striae of trabeculae enclosing very small cysts. The cortex was thinned but intact. The periosteum was not involved. Both humeri (Fig. 2) showed slight expansion and thinning of the cortex at the proximal ends, with rearrangement of the trabeculae into longitudinal strands enclosing small cystic areas. The periosteum and joint surfaces were not involved. The diseased condition extended into the epiphyseal lines but did not involve the epiphyses. The elbow joints were negative. The lower ends of the left radius and ulna (Fig. 3) showed marked expansion and thinning of the cortex, giving the ends of the bones a bulbous appearance. Longitudinal striae were pronounced, enclosing multiple cystic areas. Small cystic areas were also present in the cortex. The areas of decalcification gave the bone a mottled appearance. The periosteum and epiphyses were not involved. The ulna was considerably shortened, apparently due to the diseased condition having invaded the epiphyseal line. The carpal bones were normal (Fig. 3). The metacarpals (Fig. 3) showed the diseased condition at the diaphyseal ends. The phalanges showed similar changes to a lesser extent. Similar changes were present in the right forearm and hand (Fig. 3). Decalcification was more marked in the right ulna and a fairly large cyst was seen in the cortex on the outer side, giving the appearance of a blister. The cystic involvement was more marked in the right ulna, although the epiphysis was larger than the corresponding left side. The right ulna was also shortened and bowed slightly toward the radius.

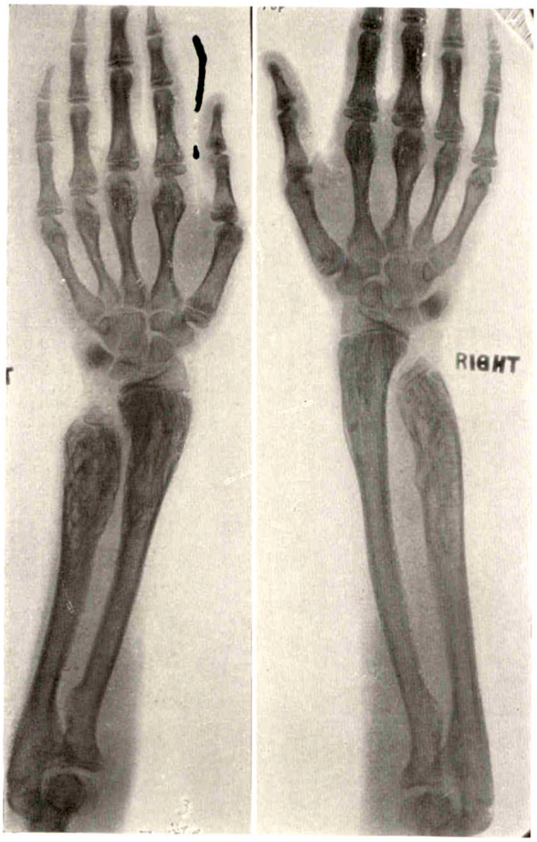

Fig. 3. Case I. Osteitis fibrosa cystica, involving the bones of both hands, the right and left radii and ulnae. The disease extends into, but does not cross, the epiphyseal lines. Note shortening of the left forearm.

The lumbar vertebrae were normal except for slight rotation upon the fifth, to the left. There was slight evidence of the disease involving the pubic bones with slight separation of the symphysis. The upper ends of the femurs showed very slight involvement. The lower third of both femurs (Fig. 5) showed changes similar to those found in the humeri. The knee joints appeared normal. The diaphyseal ends of the tibiae and fibulae (Fig. 5) showed the diseased condition. The shafts were normal. There was no bowing nor thickening of the cortex. The weight-bearing lines were normal.

The tarsal bones were normal. There was slight involvement of the metatarsals similar to the changes found in the metacarpals. The tarsal phalanges were slightly involved.

Diagnosis. A diagnosis of generalized osteitis fibrosa cystica was made based upon the roentgenographic findings. A biopsy was not permitted.

Treatment. A plaster jacket was applied to the chest with a view to correcting the spinal curvature. It was thought advisable to remove by operation the fibrocystic areas in the distal ends of the ulnae, inasmuch as growth of these bones was interfered with, but consent to operation was not obtained. The patient was instructed to avoid violent physical exercise or exertion of any kind that might cause fracture of the diseased bones. Aside from proper dietary and hygienic measures no further treatment was prescribed.

Subsequent History. The patient resumed her school work wearing the plaster jacket which was readjusted from time to time, and made no further complaints until June, 1921, when she fell while skating, fracturing the right radius and ulna (Fig. 4). The arm was kept in a splint for six weeks, at which time roentgen examination revealed good union of the fragments. Roentgen examination three months after the injury showed practically no evidence of the fracture.

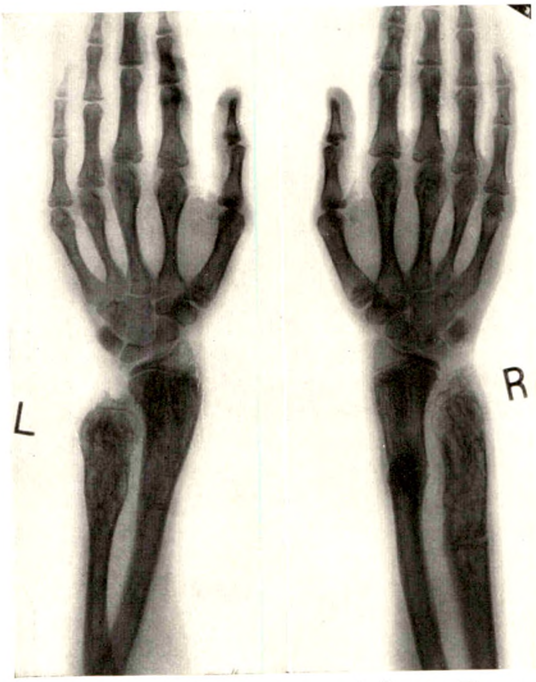

Fig. 4. Case I. Roentgenogram similar to Figure 3, made ten months later, showing fracture of the right radius and ulna. The fracture was caused by a fall while skating.

September 9, 1921. No additional complaint. Patient stated she was feeling very well and had attended school regularly. Weight 83½ lbs. (gain 11½ lbs.); height 60 in. (gain 6 in.); temperature 99; pulse 96; respiration 18; basal metabolism +2 per cent. Spinal curvature slightly improved. Calcium metabolic studies were suggested but could not be made due to lack of cooperation on the part of the patient.

September 30, 1922. Height 60½ in., weight 91 lbs. The left forearm and arm were 1 in. shorter respectively than the corresponding right extremity. She had no complaints except an occasional headache. The spinal curvature was slightly improved. Urine examination negative. No Bence-Jones bodies demonstrated. Blood—W.B.C. 5,300; R.B.C. 4,100,000; Polys. 47 per cent; S.L. 38 per cent; L.L. 7 per cent; Trans. 2 per cent; Eosin. 6 per cent.

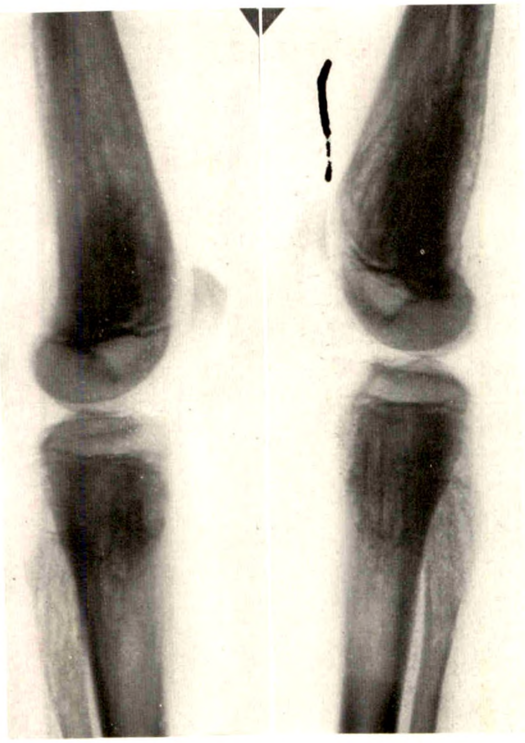

Fig. 5. Case I. Roentgenogram showing lateral view of knee joints. Note absence of joint and periosteal involvement.

Roentgenograms were again made of the entire skeleton. The condition had not progressed. There was definite evidence of healing of many of the cystic areas, revealed by an increase in the lime salts in the involved areas and increase in the longitudinal strands of trabeculae, and disappearance of the small cortical and medullary cysts. This was definitely noted in the radii and ulnae.

Case II.[1] Male, aged ten, white; first examined on Sept. 7, 1920. He complained of weakness and limp in the right thigh and leg and inability to run well.

Family History. Unimportant.

Past History. Only child; was a seven-months baby and delicate until seven years of age. Had whooping-cough in infancy. Never had been robust. First walked at age of one and one-half years. Flat feet at one and one-half years of age. Wore brace three years. At four and one-half years there was a noticeable shortening of the right leg. Operated upon in 1916 on account of bone cyst in right tibia.

Physical Examination. Poorly nourished. Walks with a lateral swinging gait and limps on right side. There is an outward bowing of the legs and shortening of the right leg. Muscle resistance weaker on right side by one-fourth. Measurements: right thigh and leg 29½ in., left 30⅜ in. Motion in legs not limited. Reflexes normal. The general examination was negative.

Roentgen examination, Sept., 1920, showed fibrocystic areas involving the upper third of both femurs. The epiphyses and periosteum were not involved. The upper third of the shaft of the left femur was somewhat expanded, with thinning of the cortex, and the bone presented a mottled, honey-combed appearance. There was considerable outward bowing. The right femur showed similar changes, which involved the upper half of the shaft. The right ilium also showed a mottled cystic area about 2 by 2½ in. in size. The left fibula was curved inward and showed degenerative changes at the middle third. The periosteum was not involved. The skull was negative except in the right posterior parietal region, which showed a pronounced thickening and overgrowth of the cortex. Other bones of the body showed no evidence of the disease.

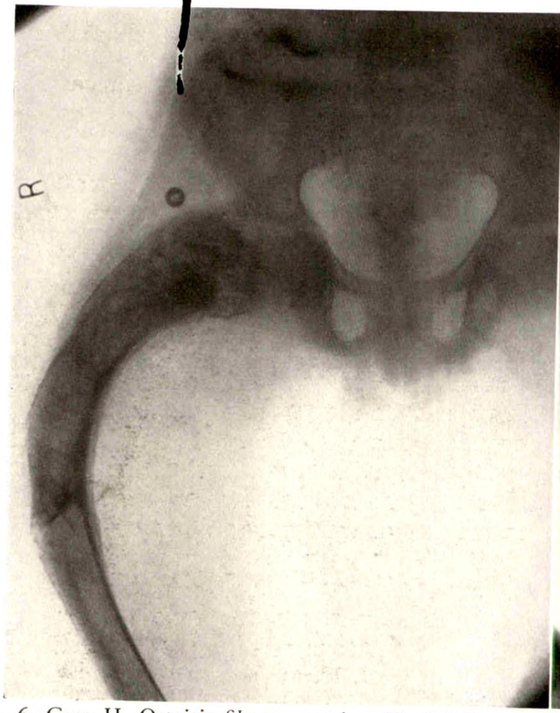

Fig. 6. Case II. Osteitis fibrosa cystica. Healed fracture of shaft of right femur. Note thickening of cortex on concave side.

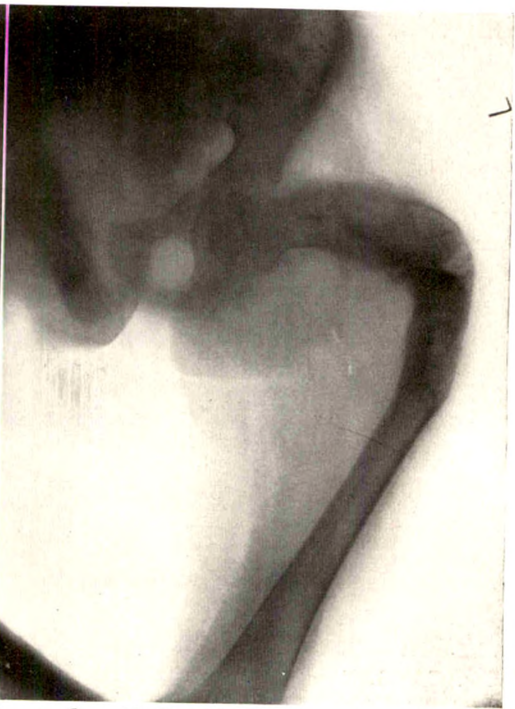

Fig. 7. Case II. Osteitis fibrosa cystica. Healed fracture of left femur with marked bowing of the shaft, giving the characteristic deformity resembling a shepherd's crook as described by von Recklinghausen.

April 13, 1921. There was marked increase in the deformity of the femurs. On Jan. 14, 1921, he sustained a fracture of the left femur as a result of injury. Subsequently, on Feb. 12, 1921, while trying to walk with crutches he fell, fracturing the right femur. Both thighs were kept in

[1] I am indebted to Dr. Chas. Venable, of San Antonio, Texas, for permission to use his records in this case.

splints for about six weeks. Roentgenograms of the left femur showed a fracture of the upper third. There was marked outward bowing and coxa vara. No evidence of callus formation or healing of the fragments was seen. The right femur was fractured at the middle third and also showed marked outward bowing and coxa vara. There was considerable callus formation around the ends of the fragments, indicating firm union. The fibrocystic changes in both femurs were as before.

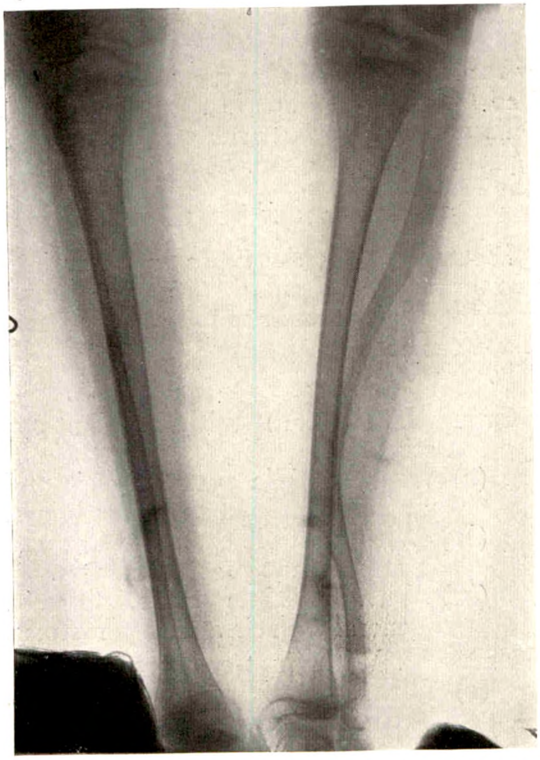

Fig. 8. Case II. Malacia and elongation of the left fibula. The fibrocystic changes in this case were most pronounced in the femurs.

Early in 1921 an open osteotomy was performed in the upper third of both femurs. The postoperative course was uneventful and the bones were considerably straightened by the operation.

Subsequent Examination. In March, 1922, there was great deformity of both femurs and the left fibula. Otherwise the patient had no complaints.

Roentgenograms of the right femur (Fig. 6) showed a marked outward bowing with coxa vara. The upper half of the shaft showed marked thinning of the outer cortex with cystic or degenerative areas scattered throughout the medulla. The inner cortex on the convex side is somewhat thickened. The entire bone appears less dense than normal, indicating absence of lime salts. The old fracture at the middle third has healed completely.

The left femur (Fig. 7) shows the upper third of the bone to be almost at right angles to the pelvis. The outward bowing and shortening of the shaft is very great. The deformed femur resembles a "shepherd's crook," the characteristic bowing as described by von Recklinghausen. The cortex on the outer or convex side is markedly thinned, whereas on the concave side it is somewhat thickened. No periosteal involvement was found. The old fracture in the upper third has healed completely. There was considerable deposition of lime salts throughout the old cystic areas, indicating healing of the diseased condition.

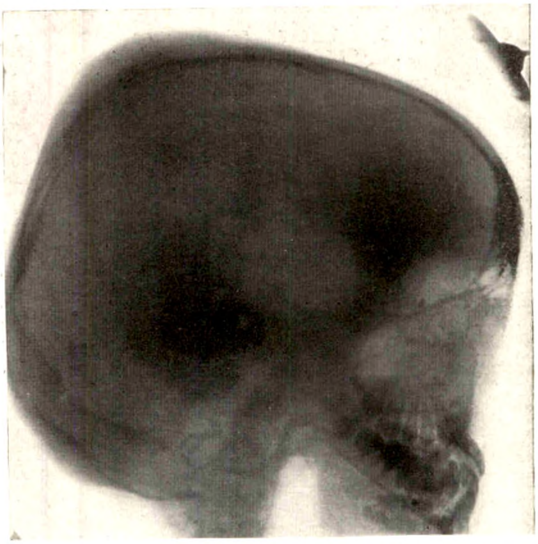

Fig. 9. Case II. Osteitis fibrosa cystica. Marked hyperostosis of the skull.

The left fibula showed a marked inward bowing, and thinning of the cortex on the convex side. The bone appears to be softened and too long for the tibia (Fig. 8).

The skull (Fig. 9) in the right parietal region shows a marked thickening or hyperostosis extending from the vertex to the posterior border of the parietal bone.

It is interesting to note in this case the combination of the fibrocystic condition with osteomalacia of the left fibula and hyperostosis of the skull.

CLASSIFICATION OF THE DISEASE

There has been much controversy regarding the relation of the disease to multiple giant-cell sarcoma, Paget's disease and osteomalacia. Hirschberg first described the disease as a form of osteomalacia. Kalisco and other observers considered Paget's and osteitis fibrosa as identical. Latzko insists that pathological changes in the bones should not be considered purely from a morphological standpoint but that they should be differentiated according to their anatomic etiology. He states: "However similar Paget's, osteitis deformans and the osteitis deformans with tumor formation of Recklinghausen may be, they are nevertheless distinct processes." Hartman suggests that von Recklinghausen's disease and Paget's are not basically different but are even closely related, that is, they are to some extent modifications of the same pathological condition which for reasons still unknown to us, appear now in one form, now in the other.

Opinion is divided as to whether the localized form of osteitis fibrosa and the generalized form are or are not identical conditions. Slesinger states that it is difficult to hazard an opinion, because of the rarity of the generalized form and the lack of sufficiently long after-histories of the localized form; but such evidence as there is would rather lead one to believe that the two conditions are not connected.

The condition is generally classified as a benign fibrocystic bone disease. Albee places this group intermediate between the benign and malignant tumors, and states that many of the cysts partake of a sarcomatous nature while others are purely innocent. According to Ewing, after the bone tissue is replaced by fibrous tissue the disease takes one of two courses, namely, the formation of bone cysts lined by fibrous tissue and filled with clear fluid or the development of giant-cell sarcoma with cyst formation. Whether the cysts precede or follow the development of the sarcomatous process, is as yet undetermined. Morton states: "There is abundant pathologic and clinical evidence at hand now, however, firmly to establish the benign nature of these giant-cell growths. They grow locally only, do not metastasize, recur only on incomplete removal, and may be removed by local operation several times if necessary." Bloodgood has demonstrated that it is a safe procedure to remove primary or recurrent growths by surgical operation. The lesions heal and do not metastasize. This observation is borne out in one case reported in this article.

CLASSIFICATION OF TYPES

Morton divides the types or stages into two groups, and subdivides each group according to the degree of general malacia of the skeleton or hyperostosis of a portion of it.

Group I (Morton) Without giant-cell sarcoma.
  (*a*) With multiple cysts, fibrosis and malacia confined to a few bones.
  (*b*1) With multiple cysts, fibrosis and predominant general malacia.
  (*b*2) With multiple cysts, fibrosis, general malacia and hyperostosis.
Group II. With giant-cell sarcoma.
  (*a*) With cysts, fibrosis and tumors, but no marked malacia.
  (*b*1) With cysts, fibrosis and tumors and marked malacia.
  (*b*2) With cysts, fibrosis, tumors, malacia and hyperostosis.

He describes at length the character of the cases in each group and of the cases in the literature: 37 are placed in Group I; 22 in subdivision (*a*); 8 in subdivision (*b*1); and 7 in subdivision (*b*2). In Group II, 26 cases are classified: 16 in subdivision (*b*1), and 10 in subdivision (*a*) and (*b*2).

PATHOLOGY

The pathogenesis of the condition is not yet known. The pathological changes found, according to Whiteman, are due to an endosteal osteoplastic metaplasia.

The most extensive and important of these changes is a transformation of the bone marrow into fibrous tissue, mucoid or fatty material, or into another tissue of the same embryological type.

There is defective calcification of the bones with rearrangement of the normal trabeculae into longitudinal strands, enclosing multiple cysts. The cysts may vary in size, shape, and number and are lined by fibrous tissue usually filled with clear fluid. Opinions differ as to the origin of the cysts and giant cells which are usually present, although giant-cell tumor formation may not be extensive. Serous transudations which lead to liquefaction and hemorrhage in the tissues are thought to play the principal rôle in the first development of cysts in the region of the fibroma. Fraugenheim doubts that this theory can be generally applied and attributes to the fibrous-like formation, degenerative qualities which may cause extensive destruction, even vesicular swelling of the bones.

In the vicinity of giant-cell sarcomata Mockenberg always found an active lacunar bone reabsorption by osteoclasts, while in the periphery of the fibrous foci and the cystic fibroma there were evidences of excessive new growths of bony tissue.

Fujii found marked changes in the periphery of the affected bone. The bone was no longer compact but was broken up into cavities and irregular trabeculae. This change was particularly noted in the bones of the extremities. Volkman perforated canals were also found. Fatty marrow was present, rich in blood-vessels, dark red in color and replaced here and there by striated connective tissue in which newly formed bony tissue appeared. The cysts apparently developed in the peripheral substance by a fibro-osteomyelitic process. The presence of giant cells, according to Mallory, is evidence of a form of osteomyelitis, due to an irritative agent. This theory was also advanced by Fujii.

In children, if the disease spreads to the epiphysis, it is probable that growth of the bones, especially the long bones, will be affected and that shortening of the individual member may result. The disease appears not to invade the epiphysis proper and the periosteum is not directly involved in the diseased process.

ETIOLOGY

The etiology is unknown. The etiologic theories may be grouped under three headings. First, pathological disturbances in calcium metabolism, in which there is an excessive withdrawal of calcium (halisteresis); second, endocrine disturbances; and third, infectious agents.

As regards the calcium deficiency, it has been shown experimentally that by feeding a diet poor in calcium the consistency of the bones may be greatly reduced, until they are easily cut or broken. This occurs in rickets and osteomalacia. However, in the disease conditions whose causation is obscure in addition to the osteoporosis, which may be produced experimentally, there is production of osteoid tissue and other complicated histological changes. These changes described by MacCallum are considered to depend upon chemical alterations and the power of the freshly produced tissue to alter the form of the dissolved calcium.

Thus the excessive withdrawal of calcium in osteitis fibrosa may be the result of a general chemical disturbance associated with the destructive bone changes.

Insufficient findings are at hand to attribute the cause of the disease to a disturbance of the internal secretions. Lotsch, however, could find no other supposition that proved tenable. In the cases studied by him, syphilis or evidence of other infectious agents were not found. No microorganisms have been found that can be held responsible for the disease in any of the cases studied.

DIAGNOSIS

Diagnosis is made from the characteristic roentgen-ray findings and the history of pain in the joints and extremities of a rheumatic nature, fracture as a result of some trivial injury, and deformities, such as bowing and shortening of the long bones. The condition must be differentiated from osteomalacia and Paget's disease. In the latter diseases the history of the onset, characteristic deformities and roentgen-ray findings should make the diagnosis of these conditions fairly easy.

ROENTGEN-RAY FINDINGS

There is an expansion of the bones without thickening of the cortex. The periosteum is not involved, except where fractures have occurred. Small cystic areas are seen scattered throughout the cortex and the bony structures are replaced by irregular strands of trabeculae enclosing multiple cysts which vary in size and shape. The bones have a mottled appearance, due to the cystic areas and absence of calcium salts. The cortex is usually markedly thinned and may be destroyed. The process does not involve the epiphyses. Lesions occurring in the region of the epiphyseal lines may cause shortening of the bones due to interference with growth. There is absence of periosteal involvement. Hyperostosis may be seen in the cranial bones, resembling Paget's disease, but there is no roughening of the periosteum and marked subperiosteal cortical bone thickening, especially in the tibiae, as found in Paget's disease.

TREATMENT

Nothing is known that will arrest the course of the disease. Cases treated medicinally with phosphorus, calcium, arsenic, and glandular extracts have shown no apparent improvement. Operative procedures may be instituted in the treatment of the fractures and removal of the fibrocystic areas. However, removal of the cystic areas in all the affected bones can seldom be accomplished, on account of the general distribution of the disease. At the site of fractures and where the fibro-cystic areas extend into the epiphyseal lines interfering with growth of the bones, operative removal of the cystic areas is indicated. Young and Cooperman treated a patient with radium and roentgenotherapy without any effect upon the course of the disease.

The disease may run a course of a few months or may be present for many years. Death usually occurs from cachexia or intercurrent disease.

CONCLUSIONS

1. Generalized osteitis fibrosa cystica is classified as a benign fibrocystic bone disease of rare occurrence. Its etiology and pathogenesis are unknown.

2. The disease presents the following characteristics:

(*a*) Insidious onset with slight subjective symptoms or absence of them, usually occurring during the epiphyseal age period.

(*b*) Involves all bony structures. The epiphyses and periosteum are not primarily involved.

(*c*) Transformation of the bone-marrow into fibrous or osteoid tissue, decalcification of the bones with cysts, giant-cell tumor formations, osteomalacia or hyperostosis of the affected bones.

(*d*) Bony deformities, resulting from pathological fractures, hyperostoses, bowing or softening.

(*e*) Benign in character; lesions do not metastasize and may be removed by operation.

(*f*) Spontaneous healing of the cystic areas, especially where fractures have occurred.

(*g*) Chronicity; the course is of long duration and the progress slow.

3. The roentgenographic appearance of the diseased bones is typical.

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CHONDROGENESIS IMPERFECTA-ACHONDROPLASIA-CHONDRODYSTROPHIA FETALIS*

With a Report of 6 Cases and 1 Operation

BY

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NOMENCLATURE

Achondroplasia (Parrot) or absence of cartilage is not so accurate a term as chondrodystrophia fetalis (Kaufman) which signifies abnormal development of cartilage. Osteochondrodystrophia fetalis is a better term than chondrodystrophia fetalis. Other terms used in describing this condition are dwarfism, fetal rickets, congenital rickets, fetal cretinism (Horsley, Virchow), pseudorachitism, pseudorachitis fetalis, micromelica, cretinoid dysplasia, chondritis fetalis, cartilaginous dysplasia, nanism, micromelia and chondromalacia.

One of the writers, (P. L.) suggests a name corresponding with the descriptive term osteogenesis imperfecta, i.e., chondrogenesis imperfecta, or osteochondrogenesis imperfecta.

HISTORICAL

Dwarfs were recognized in ancient history as sacred beings—idols, to be worshipped. During the middle ages the most prominent rôle these individuals played was that of court jester; they were valued for their precocity and eccentric appearance. In modern times they have been conspicuous as actors, mirth-exciting and abnormally strong as compared with their size. They are found in all circuses or "side-shows." Many nobles have had them as mascots.

The figures of the gods Phthah and Bes in ancient Egypt were dwarfs as were those in the canvasses of Velasquez in more recent times.

The most important contributions to the literature on this subject have been made by Kaufman, Jansen, Marie, Apert, Cestern, Gilford, Porek and Durante, Emerson, and Rischbieth and Barrington.

ACHONDROPLASIA IN ANIMALS

The most striking example is that of the dachshund. Others are the pug dog, guinea pig, Ancon sheep, Nato's cows of Chili, Yorkshire pigs, and the bull-dog calf; the last named having a very short snout, short legs and thick wrinkled skin, but normal development of the short bones.

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* Read at the Twenty-fourth Annual Meeting of The American Roentgen Ray Society, Chicago, Ill., Sept. 18–21, 1923. This paper is based on the observation, and in some cases the intimate study, of 13 real dwarfs and 59 midgets.

There was very recently at the Hotel Pennsylvania in New York City, a baby hippopotamus, shipped from Hamburg under the personal direction of Heinrich Hagenbeck. It belongs to a rare tribe of pygmies of which there are only five in captivity. Two of these are in London and two in Bronx Park, New York. It is perfectly formed and at the age of eighteen months is but 28 in. in height and weighs only 126 lbs. When it reaches its full growth at the age of two and one-half years, it will weigh not more than 250 lbs. as contrasted with the 3,000 to 3,800 lbs. usual for a normal adult hippopotamus. The valuable young animal is very delicate and requires the most painstaking of care. Accompanying it as caretaker is an animal expert who attends it day and night. The animal is never uncovered for a moment lest it take cold, and its daily regime includes a bath and carefully supervised feedings. It is very gentle and affectionate, a perfect pet.

In the vaudeville troup known as Singer's midgets, there are midgets of the following animals: pony, monkey, elephant and Pekinese dog.

ETIOLOGY

The etiology of chondrodystrophy is a subject of discussion; the most probable explanation is that of Mürk Jansen of Leiden, Holland. He believes that all the symptoms can be explained by the assumption that the amnion, remaining too small, enhances the normal infolding of the embryo in the fifth or sixth week of embryonic life; that it, at that time, increases hydrostatic pressure inside of the amniotic sac and squeezes the blood out of the fetus during the formation of its cartilaginous skeleton. Some writers criticize this theory on the ground that if it were due to pressure there should be transitional stages. The writers believe there are transitional stages and have grouped them under the term pseudo-dwarfs.

Other theories are the glandular, the metabolic, the rachitic and the infectious.

Wagner put forth the theory that dwarfism is due to premature inhibition of cartilaginous growth by excessive gonad hormones, i.e., dwarfs are the opposite of castrated or eunuchoid individuals. The gonad secretion controls the closure of the epiphyses. Engelbach and Tierney believe it is possible that a hypergonad secretion allows early ossification and decreased growth of long bones. In hypogonadism the inhibitory effect of the gonads is missing and the long bones over-grow.

Sex does not seem to be a factor.

Society is a very important factor in view of the fact that practically all cases are among the poor class.

Heredity is probably a negligible quantity.

Color. The literature consulted revealed but one case among negroes. Elliott states that Christopherson presented the skeleton of an achondroplastic negro to the museum in London. If rickets were an important factor, one would expect to find achondroplasia commonly among negroes which race furnishes much of the rickets encountered. However, dwarfism is very rare among the colored race. (The writers have seen two colored midgets, one of whom was born in Java.)

BASSOE'S CLASSIFICATION OF DWARFS

1. Proportionate dwarfs
    - (*a*) Primordial dwarfs (essential microsomia)
    - (*b*) Hypophyseal dwarfs
2. Disproportionate dwarfs
    - (*a*) Achondroplasia (chondrodystrophia fetalis).
    - (*b*) Stunting of growth from rickets or Pott's disease
    - (*c*) Cretinism
    - (*d*) Congenital syphilis

HASTINGS GILFORD'S CLASSIFICATION

1. Racial or Phylogenetic dwarfism
2. Ontogenetic or individual dwarfism
    - (*a*) Primary or essential
    - (*b*) Secondary or symptomatic

PATHOLOGY

The pathological process begins in fetal life and consists in a disturbance of the normal ossification of primary cartilage. It is a dystrophy of the epiphyseal cartilage. It affects endochondral ossification only, never the intramembranous type except in severe cases. The bones of the extremities are, therefore, usually affected, while those escaping are the vault of the cranium, superior maxillae, malars, nasals, lachrymals, palate bones, vomer and internal pterygoid plate.

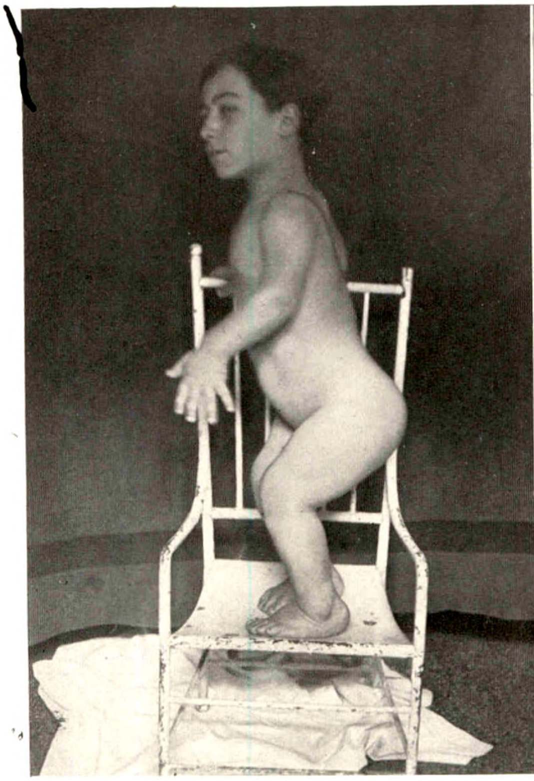

Fig. 1. Case I. Before operation.

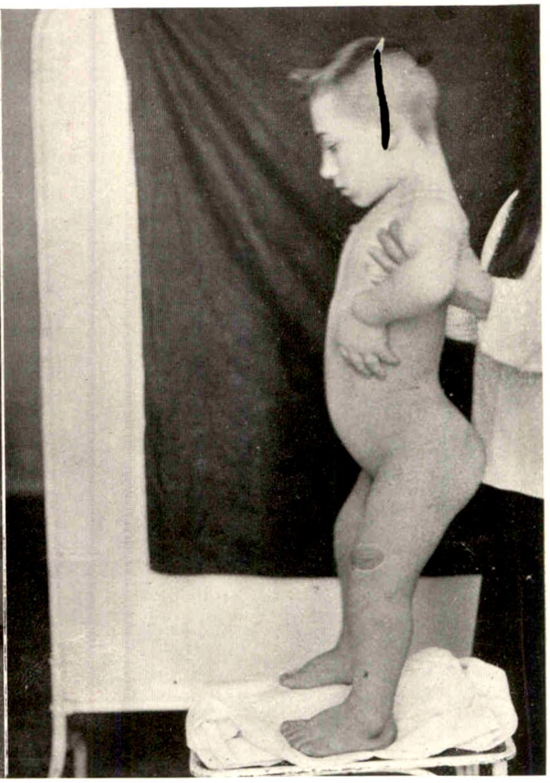

Fig. 2. Case I. After operation.

According to Adami and Nichols, growth in the length of the bones is seriously interfered with, due to faulty ossification at the epiphyseal lines, but periosteal ossification is practically normal, with the result that the bones become short, plump and thick.

Kaufman Types:

1. Chondrodystrophia malacia
2. Chondrodystrophia hypoplastica
3. Chondrodystrophia hyperplastica

In Type 1 the cartilage at the ends of long bones is to some extent increased in size, but no columns of cartilage cells are formed. The cartilage in places is softened and in others is irregularly ossified.

In Type 2 ossification of cartilage is diminished, the columns of cartilage cells are small, the cells themselves are deficient in growth, being spindle-shaped, irregularly arranged, and having the appearance of being compressed. The hyaline matrix is more or less soft and homogeneous.

In Type 3 there is marked overgrowth of cartilage leading to notable thickening at the epiphyseal ends of the bones. Ossification is extremely irregular. These types may be different phases of the same affection.

Skull. The skull shows the characteristic depression at the base of the nose, causing a "pug nose." The vault of the skull is very large and round, showing a thinning of the bones. The skull tapers at the base. This is due to the ossification of the sutures at birth. The sutures in the vault ossify late, because of the increased intracranial pressure. The early ossification of the basal sutures causes a narrowing of the base, which, in turn, causes the compensatory expansion of the vault. With this there is a delay in the ossification of the fontanels. The obliteration of the cartilaginous fissure of the skull in utero causes a deficient linear development of the base, which in turn leads to a marked depression at the root of the nose.

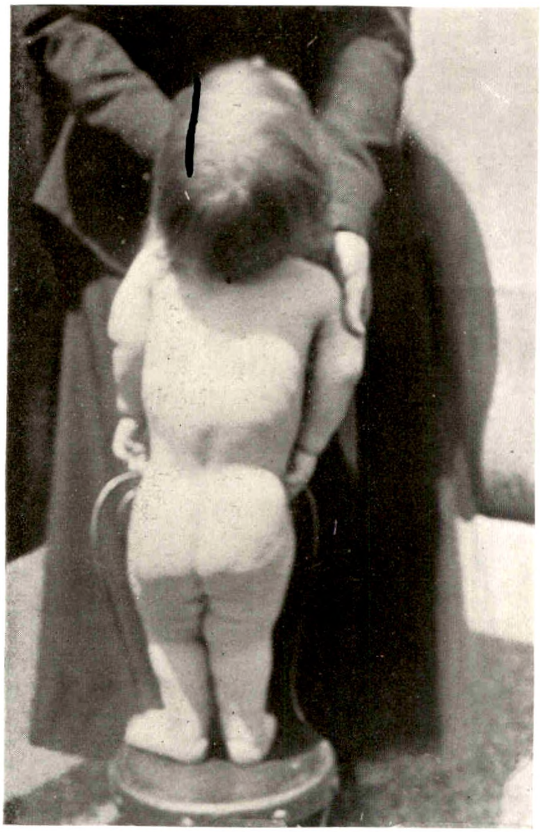

FIG. 3. Case II.

These factors are the cause of the diminution of the angle and the decrease in size of the foramen magnum. That portion of the base of the skull formed by the occipital and sphenoid bones, the "os tribasilaris" consists at birth of three pieces, the basilar portion of the occipital bone and the pre- and post-sphenoid bones. The synchondrosis intersphenoidalis unites at about the time of birth. But the cartilage uniting the sphenoid and occipital bones is not solid until about the eighteenth or even the twenty-fifth year. "On the existence of this cartilage depends the development of the base of the skull, and therefore, the brain" (Virchow)

In the achondroplastic stillborn infant these bones are often firmly united, and the clivus deprived of the possibility of growth in length. This was noted by Sartorius in 1826. The clivus is in these cases abnormally vertical ("Kyphosis of the Skull" Virchow). This shortening of the base of the skull from 7.6 cm., the normal, to 4.6 cm. or even less, explains, according to Virchow, the depressed root of the nose.

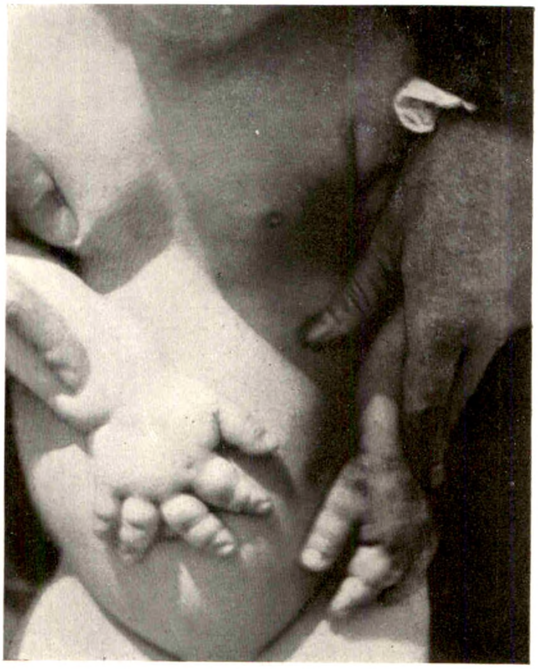

FIG. 4. Case II. Typical hand deformity.

The receding upper jaw is quite evident when compared with the prognathous appearance of the lower jaw. Here again the basal kyphosis is the cause. The sella turcica is very dense, having the appearance of sclerosis. The pituitary fossa is shallow and narrow.

Chest. In comparing the normal with an achondroplastic thorax, one is impressed with the loss of the curve of the ribs. The ribs posteriorly are straight. The chest is broader than normal. The ends of the ribs are greatly widened and flaring. The clavicles are straight, the normal curve being lost.

There is no evidence of a rosary, as seen in rickets. There is no change in the lungs. The area of density along the sternum, so frequently seen in rickets, is not present in achondroplasia.

Spine. The entire spine shows a great many changes. The bodies are compressed. The articular surfaces are very irregular. The intervertebral spaces are greatly increased. (The liver is much enlarged.) The sacroiliac joints are widely separated. The sacrum is rarefied.

Pelvis. The pelvic outlet is greatly decreased. The obturator foramen is greatly enlarged. The acetabulum is eroded. The articular surface is very irregular. The head of the femur is not developed. The neck is very irregular. The greater and lesser trochanters are normal.

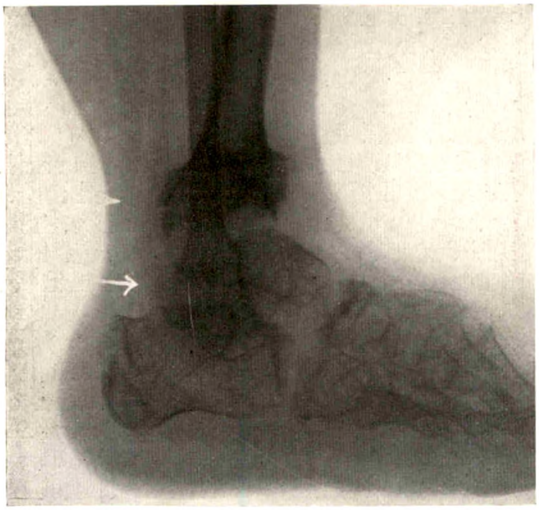

Fig. 5. Case I. Ankle region showing epiphyseal changes.

Femur. The shaft of the femur is curved forward and backward, and greatly shortened. The bowing is more pronounced in the lower third. The cortex of the bone is greatly thinned. The diaphysis of the femur is thickened, with considerable flaring. The pathological process involves both the epiphyses and the diaphyses. The epiphyses are irregular and very porous. The articular surface of the lower end of the femur is very irregular.

Tibia and Fibula. The epiphyses of the tibiae and fibulae are very irregular and are "mushroomed." The epiphysis is partially destroyed. There are a great many areas of rarefaction in the bone.

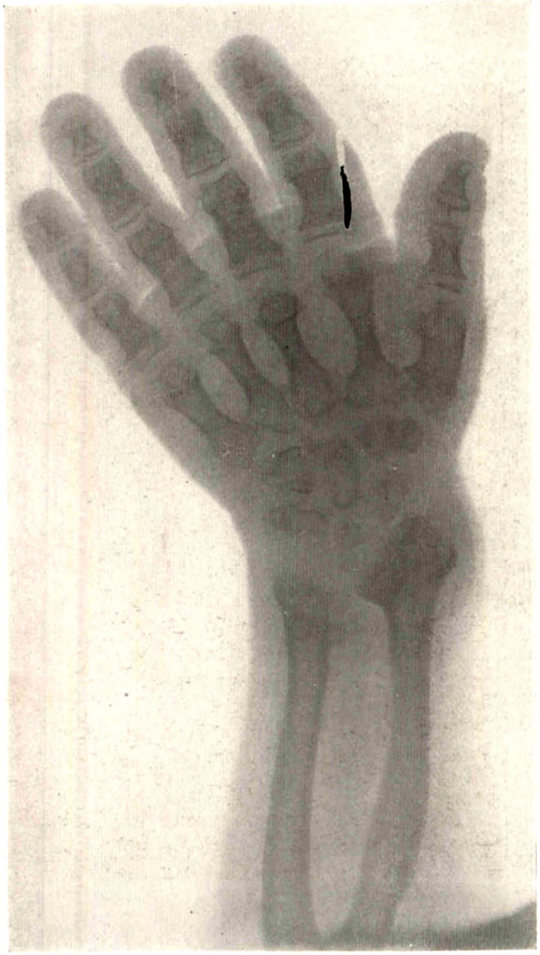

Fig. 6. Case I. Hand and wrist.

Foot. The bones of the foot are porous. The osteoporosis is not like that usually seen resulting from atrophy. The Haversian canals are very prominent, giving the bone a streaked appearance. The bones are soft, with areas rich in calcium salts—trabeculae. The cortex is usually thin. The articular surfaces are very irregular. Some of the bones of the foot are not developed, such as the navicular, cuboid and cuneiform.

Hands. The hands are short and broad. The fingers are about the normal length. The middle and ring fingers often become separated from each other at the ends. The fingers form three groups: (1) the thumb, (2) the index and middle finger, and (3) the ring and little finger—the so-called "trident hand." (A trident is a three-pronged and a bident is a two-pronged fork or harpoon.)

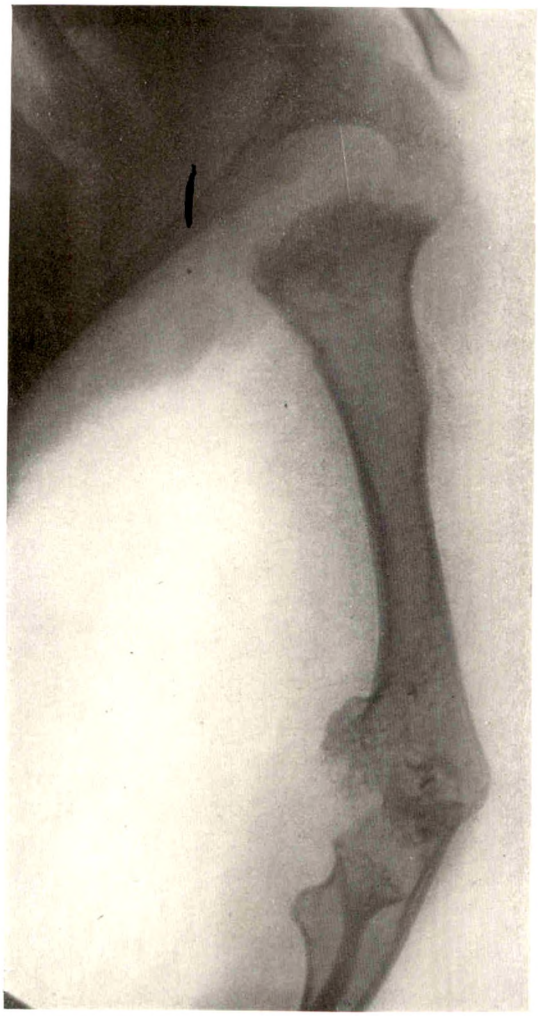

FIG. 7. Case I. Epiphyseal changes at elbow and shoulder.

The metacarpal bones form a semicircle, coming off the carpals like the spokes of a wheel. The carpal bones are irregular in outline and small, due to a delay in ossification. The proximal row of carpals seems more extensively involved than the distal. The metacarpals are short and their epiphyses are broader than normal.

SIGNS AND SYMPTOMS

The cardinal sign of chondrodystrophy is the disproportion between the body-length and the length of the extremities, i.e., the body-length is normal and the arms and legs are very short. A dwarf erect is analogous to a dachshund standing on his hind legs. The late J. B. Murphy used to say he was "a dog and a half long and half a dog high."

The center of the body is displaced downwards, i.e., the umbilicus is below the transverse mid-line of the entire individual. After one year of age the umbilicus should be half-way between the head and feet. The head is large, the vault is large, but the base is short. The expression is alert and humorous. The bridge of the nose is depressed—"pug-nose." There is an excess of fat and skin which hangs in folds. The skin seems too large for the body.

The arms do not reach down as far as normally. The hands are short, chubby and flabby, the fingers are nearly all the same length, giving the hand a square shape. The ends of the fingers are separated as though wedges were inserted at the roots. "(Main en trident" or three-pronged fork of Marie. "Main en bident" or two-pronged fork.) The phalangeal epiphyses are large. The angle subtended by the second and fifth metacarpal shafts is about 40° instead of the normal 32°.

There may be flexion deformities at the hips, knees and elbows, as shown in Case I of this report. Limitation of extension of various joints may be common. In Case I there is possible hyperflexion of the elbows but limitation of abduction at the shoulders and hips.

The abdomen is prominent and there is an exaggerated lumbar lordosis. An arcuate kyphosis may be present. If rachitic, the usual signs of that condition are present. According to Philip Hoffman the acromial end of the clavicle is lower than the sternal end, i.e., the reverse of normal.

Muscle weakness is usually very great during infancy, childhood and adolescence. After adult life is reached it may give way to great strength (especially in proportion to size).

Sexual powers are usually normal or

increased. If pregnancy occurs, a Caesarian section is necessary because of the deformity of the pelvis. (Cretinoid dwarfs are usually sterile.)

Mentality is below normal, but far from imbecilic. They are good-natured.

Dentition is slightly delayed.

Walking is usually delayed until the third or fourth year.

and are readily recognized. There are, however, a number of bone diseases encountered in which the roentgen findings are quite similar to achondroplasia, and only after a thorough study of the films and the careful taking of a clinical history can a diagnosis be made in some cases.

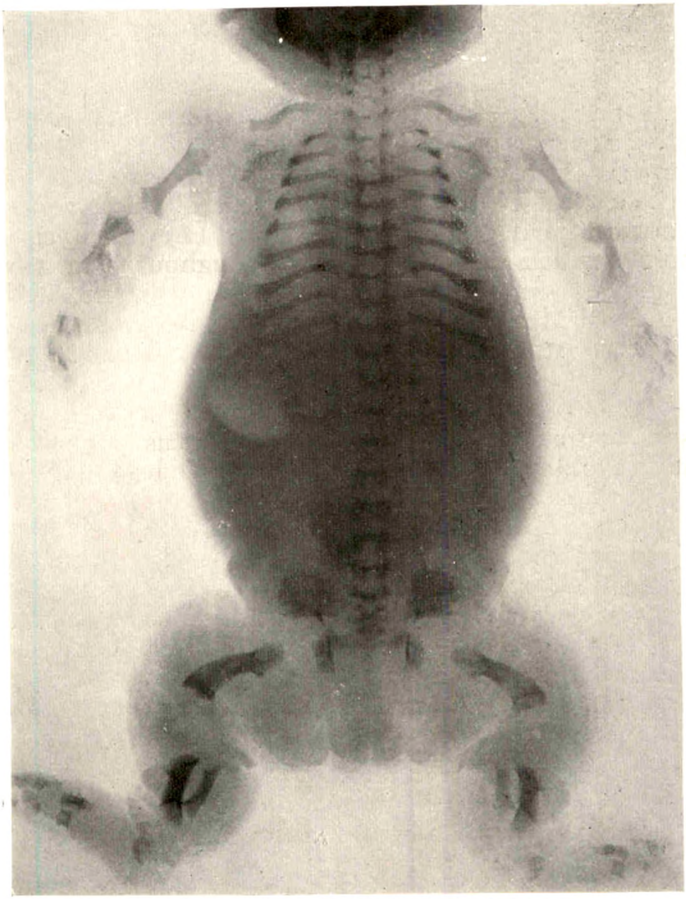

FIG. 8. Case III. Practically entire skeleton.

Achondroplasia involves especially the epiphysis and the epiphyseal cartilage, and thus, usually from these changes, a diagnosis can be made. The interference with the epiphysis leads to a much retarded growth, and oftentimes complete arrest of development follows. The disease is not confined to any or to any one group of bones. Practically the entire osseous system may be involved. The bones formed in membrane usually escape except in the very serious cases. The bones formed in cartilage are affected to a degree determined by their formation, the earliest formation being affected the least, the latest, most. The

Jansen states that achondroplasia and dysostosis cleidocranialis are often associated with other congenital malformations such as spina bifida, congenital club-foot and many others. Achondroplasia has been observed to be attended by mongolian idiocy as the latter is constantly accompanied by symptoms of achondroplasia (Van der Scheer).

ROENTGEN-RAY FINDINGS

The roentgen findings in most cases of achondroplasia are quite characteristic most common location is, however, in the ends of the long bones, and it is here that the changes are quite typical. The ossification at the epiphysis seems to occur at an early date, and it is not uncommon to see complete fusion of the epiphysis in a very young child. The ends of the bones become very dense, and in many instances broadened, showing a very marked flaring. The periosteum seems to show no changes, consequently bone is not laid down in excess, and as a result, very little widening of the shaft is noted.

In comparing the normal thorax with that of an achondroplastic, one is impressed with the loss of normal curve of the ribs in the latter. The ribs, instead of extending downward and forward, are practically straight. The chest is much broader than normal, and the ends of the ribs are widened, and show a marked flaring. The clavicles are straight, the normal curve being lost.

There is no evidence of a rachitic rosary and the areas of increased density seen along the sternum in rickets are not present in achondroplasia. The spinal column shows a great many changes. (It is not uncommon, however, to find the spine unaffected.) The bodies are narrowed, rarefied and very irregular. The narrowing of the bodies leads to a widening of the intervertebral spaces. The articular surfaces of the bodies are irregular and thickened. The normal curves of the spine may not be greatly exaggerated. In comparing the sacroiliac joints there seems to be a great widening of the joints with a roughening of the cartilaginous surfaces. The sacrum is rarefied, but shows complete development of all segments.

The general anatomy of the pelvis is quite striking when compared with the normal. The size of the outlet is greatly decreased while the obturator foramina are enlarged. The general appearance of the bones leads one to believe that they are soft and decalcified. The heads of the femora are not developed and the necks are located in the shallow acetabular cavities. The greater and lesser trochanters are as a rule quite normal. The femora are very short and there is a decided anteroposterior bowing, the latter especially in the lower third. The general appearance of the cortex is quite characteristic in that there is a very noticeable thinning.

In the distal diaphyses of the femora there is a definite thickening, band-like in structure, which seems to block any further growth. At this region there is flaring and widening of the bones. The epiphyses are poorly developed, irregular and porous, and the articular surfaces are exceedingly rough. In the very advanced cases there may be great distortion of the femora. As early as 1906 Freiberg described and showed a roentgenogram of the hip of a typical chondrodystrophic dwarf. The distal ends of the tibiae are widened and have a mushroomed appearance. The epiphysis is only rudimentary. Throughout the tibia are many small areas of bone rarefaction. There is a very definite band of thickened bone at the distal end of the tibia. The fibula is usually too long for the tibia. The head reaches to the knee while the external malleolus extends too low down. Throughout the bones of the feet there is a generalized osteoporosis, which is unlike that which commonly follows atrophy of disuse. The Haversian canals are very prominent, giving the bones a streaked appearance. The bones seem soft and are spotted with many small areas rich in calcium. The cortex of the bones is unusually thin. The articular surfaces of the tarsal bones are very irregular. The centers of ossification of the bones of the foot appear very late, and in one case, at the age of fourteen the navicular, cuboid and cuneiform had not appeared.

The hands are quite characteristic, the metacarpals being short and broad. The phalanges are normal in length. The middle and ring fingers often become separated from each other at the ends. The fingers are formed into three groups: (1) the thumb, (2) the index and middle and (3) the ring and little finger. This is the so-called "trident hand."

The metacarpals form a semicircle coming off the carpals like the spokes of a wheel. The carpal bones are irregular in outline and small, due to the cartilaginous changes and their late appearance. The proximal row of carpal bones seems more extensively involved than the distal. The metacarpals are short and their epiphyses are broader than normal.

DIAGNOSIS

Direct Diagnosis. There should be no difficulty in making a diagnosis of chondrodystrophia fetalis. Whether the subject is seen immediately after birth or several years later, the disproportion between the normal length of the body and the short arms and legs determines the diagnosis. The large vault of the cranium, depressed bridge of nose, abnormal folds of skin and fat, especially of the lower extremities, deformity of the hands, weakness of muscles and roentgenologic findings are corroborative.

Differential Diagnosis. Between the types of dwarfing. The various kinds to be differentiated are as follows:

1. True chondrodystrophia fetalis, in which no definite etiology is suspected.
2. Cretinoid type in which the evidence of cretinism is marked, i.e., typical facies, thick tongue, mouth breathing, dry skin, straw-like hair, mongolian eyes, deficient mentality, etc.
3. Hypophyseal type, as evidenced by changes in size and shape of sella turcica and disturbed carbohydrate metabolism.
4. Pluriglandular type, in which one is impressed with the glandular element, but the specific gland cannot be determined.
5. Rachitic type, in which the cardinal signs of that disease are present, viz., enlarged epiphyses, square forehead, delayed closure of fontanelles, rachitic rosary, Harrison's groove, flared costal borders, pot-belly and lumbar lordosis. There is no reason why a true dwarf may not develop rickets as well as an ordinary child, the rachitic condition being entirely a secondary affair.

DIFFERENTIAL DIAGNOSIS

1. *Rickets* is a disease of very early childhood, especially during the first two years. It involves especially the epiphysis. The saucer-shaped epiphysis is quite characteristic of rickets. The joint is intact. Fractures are apt to occur in rickets, and are very rare in achondroplasia. The two conditions are, however, often associated. Other evidences of rickets are the enlarged epiphyses, bone deformities such as genu varum and valgum, pigeon breast, square forehead, rosary, etc.

2. *Syphilis.* Hereditary syphilis also occurs in the very young, usually during the first two years of life. The joint is intact, and the epiphysis and epiphyseal line are normal. Syphilis attacks the ends of the diaphyses, showing small irregular areas of rarefaction. Periostitis, periarticular swelling and fluid are usually present in syphilis, and absent in achondroplasia. Swelling of the joint is often present in congenital lues. Joint involvement is usually multiple. Syphilis is not so extensive as achondroplasia, only a small portion of the bone being involved. The Wassermann reaction and anti-luetic treatment are of great diagnostic value.

3. *Osteogenesis Imperfecta* (Lobstein's disease). The changes in osteogenesis imperfecta usually occur in the shafts of the bones, the joints being uninvolved. Fractures may be numerous, which condition is rare in achondroplasia. There is a general decalcification of the bones, making it difficult to obtain a good roentgen film. The differential point lies in the fact that in osteogenesis imperfecta, the epiphyses are intact, while in achondroplasia the gross changes are in this area. Osteogenesis imperfecta is differentiated by the multiple fractures of the long bones, history of pathological fractures and the normal proportions of body and extremities. The two conditions are sometimes associated.

4. *Cretinism.* The condition which is frequently to be differentiated from achondroplasia is cretinism. The differential diagnosis between achondroplasia and cretinism may be impossible from the roentgen-ray evidence alone. The careful taking of a history with the usual findings of cretinism or dwarfism is necessary to differentiate the two diseases.

5. *Scurvy* is a disease of early childhood. The joint in scurvy is normal. The pathology is located just behind the epiphyseal line. At this area a destructive zone is located (Trommer's zone). In scurvy subperiosteal hemorrhages are prone to occur, which is not true in achondroplasia. Pain and sensitiveness to jarring may be extreme

in scurvy. The changes in scurvy are less general and usually respond miraculously to treatment.

Osteomalacia is a disease of late life, whereas dwarfism is a condition found in infancy. Osteomalacia affects the shafts of bone, whereas chondrodystrophia disturbs the epiphyses chiefly. Osteomalacia is very rare in males; chondrodystrophy is as frequent in males as females.

Hydrocephalus should be distinguishable without much difficulty.

Midget. In this group belongs the most interesting class of small people. What differentiates a midget from a dwarf? The answer is very simple. The definition of Brennemann is perfect, viz., "A midget is a man or woman looked at through the wrong end of the opera glasses." A midget is of normal form, but diminutive. A dwarf is a disproportioned or deformed individual.

PROGNOSIS

The prognosis as to life is only fair. Most dwarfs are stillborn. Of those born alive, the majority die soon after birth or in early infancy. Those who survive frequently live to a great age. The chances of reaching normal height are hopeless. Rarely do they grow taller than 3½ or 4 ft. If adult life is attained, the acquisition of unusual strength in proportion to the height is quite common. Where contractures and deformities are present it is necessary to continue orthopedic treatment of correction and retention for many years, i.e., until all tissues involved have assumed a permanent condition.

TREATMENT

The treatment varies with the individual case and is rather simple when the type of deformity is differentiated.

Cretinoid Types. If one has a cretinoid type to deal with, the administration of thyroid by mouth in doses ranging from ⅒ to 5 gr. three times daily is indicated. (It has for several years been the desire of one of us (P.L.) to transplant into some such location as the abdominal wall of a cretin, a lobe of human thyroid, which might save the continued giving of the gland by mouth.)

In the *rachitic type*, heliotherapy plus an anti-rachitic diet should be prescribed, emphasizing the importance of fresh fruit juices, fresh vegetables, mixed diet, containing vitamines, crisp bacon, etc., and the internal administration of phosphorus and cod-liver oil, in a mixture as follows:

Phosphori gr. ⅙
Olei Morrhuae ℥ii.
M. et. ft. sol.
Sig. ʒ i t.i.d. a.c.

Phosphorized cod-liver oil is excellent because the dosage is reliable.

Hypophyseal Type. If it can be definitely demonstrated that the sella turcica is unusually small and therefore the hypophysis probably undersized, there is an indication for the intensive administration of hypophysis gland by mouth and hypodermically. If toxic symptoms develop, one-half the dose may be continued as a physiologic dose or the gland withdrawn temporarily and another substituted. A small-sized sella may be very misleading and does not always indicate hyposecretion of the hypophysis. (Engelbach and Tierney.)

Pluriglandular Type. For those cases which are thought to be of glandular origin but definitely non-cretinoid, the internal administration of various glands successively is a matter of hit or miss, but a method that should be tried. It is advisable to alternate for periods of two months each with various glands, as follows: For a child of ten years, anterior lobe of hypophysis, gr. 5; Pineal Gland, gr. ½; Thymus Gland, gr. 5; Thyroid, gr. 2. Each gland should be given three times daily and untoward effects watched for carefully.

Orthopedic treatment of contractures and deformities consists in correction and retention. The treatment given the case below is an illustration. It must be continued over long periods in order to prevent recurrences and occasionally controlled by roentgenologic study.

Case Report: Male, white, aged thirteen, of Swedish parentage, a pupil at the Fallon School for Crippled Children. Entered St. Luke's Hospital Oct. 2, 1919, on the service of Dr. John L. Porter. He was brought to the hospital to have "bow-legs" corrected. As a baby, he seemed to be normal. He was always heavy. Began to walk at nine months but very soon became ill and did not resume walking until eighteen months old. At the age of four years his parents noticed his arms and legs were not developing as rapidly as his body, and as he increased in weight his legs became "more bowed." The length of arms and legs has not increased perceptibly since he was four years old. He is weak, and cannot walk any distance as compared with other children. He is alert, responsive and in the fifth grade at school. Had scarlet fever, tonsillitis, diphtheria, chicken-pox, whooping-cough and the above-mentioned illness at nine months of age. His mother is of normal size and in good health. Her health during pregnancy was very good. His father was a normal-sized man. Two sisters, aged sixteen and eleven, and one brother, aged four, are of normal development and health.

Physical Examination. Patient is an undersized boy, 38½ in. in height. His body is of normal length, but his arms and legs are very short. Walks without aid but has a waddling, shuffling gait. He stands in a peculiar attitude with marked lumbar lordosis, prominent buttocks, flexion of thighs and knees, and varus position of feet. Flexion of elbows with increase in carrying angle (cubitus valgus). Marked weakness of entire musculature.

Head: greatest circumference 21 in.; fontanelles closed; hair, thick, fine and light brown in color; scalp, normal; eyes, reflexes normal, appearance normal; ears, normal. Mouth, molars carious. Throat, tonsils hypertrophied and hyperemic. Neck: glands; posterior cervical group palpable, upper anterior cervicals palpable. Thyroid palpable but not enlarged. Chest: diameter; angle of the scapulae and nipple line 25 in. Expansion ½ in.; heart, negative; lungs, negative; lower costal margin flaring and prominent; Harrison's groove present. Abdomen, negative. Back, marked lumbar lordosis.

Arms: length from posterior angle of acromion process to tip of index finger, 15¼ in. There is a groove to admit the tip of the index finger between the tip of the greater tuberosity and the acromion process. The arms can be raised only to the level of the shoulders. The forearms extend only to an angle of 45°. Wrist joints large, i.e., lower epiphyses of radii and ulnae enlarged. Hands are wide for the length, stubby, flabby. Main en trident. Hands are very weak. Epiphyses of phalanges very thick.

Lower limbs: In erect position thighs are flexed to an angle of 45°. These cannot be extended. Tibiae are curved outward, the curve being most prominent in the lower third. The external malleoli are large and prominent due to enlargement of epiphyses.

Feet: length from heel to tip of second toe is 6¾ in. Width at widest portion is 3¼ in. There is a partial syndactylism of the second and third toes of each foot. There is bilateral equinovarus.

Roentgen-ray Findings: sella turcica very small and especially so in proportion to the size of skull.

The parents were given very little encouragement and were told it was probable that 1 or 2 in. might be added to the boy's height. They were willing to try anything. He was put to bed and Buck's extension applied to both legs. After one week without improvement he was given ether and operated upon (P.L.) on Nov. 10, 1919. Over the foot of the Hawley table a great deal of force was used, the knee flexion and various deformities were corrected and plaster casts applied with knees extended and the feet in slight valgus Then using the legs encased in casts as long levers with the buttocks held down, the hip flexion was forcibly overcome and a double plaster of Paris spica applied from above the costal margins and joined to the leg casts. He had no trouble whatever in taking the ether and no pain following the operation. This cast was removed at the end of five weeks. Measurement of his body length showed 42 in., an increase of 3½ in. in five weeks. November 10, 1920, one year subsequent to operation his length was 42⅜ in. Because of his inability to walk it was deemed advisable to apply simple leg and foot casts and to recommend crutch locomotion. After about four weeks one leg cast was removed and a single spica of the hip applied to that side. Six months after operation. all casts were removed. He was given anterior lobe of hypophysis 2 gr., three times daily. Massage, active and passive motion and stretching of arms and legs (but not of the body) were given by a nurse from the Visiting Nurses Association. He was instructed not to sit down much, because of the danger of recurrence of hip and knee flexion deformities, but should spend most of his time standing or walking with crutches, or lying down. The further treatment will consist in alternating the hypophysis with pineal gland, thymus and thyroid, the occasional application of a leg or hip spica and infrequent examinations by the roentgenologist.

BRIEF SUMMARY

A midget is a man or woman looked at through the wrong end of the opera glass, that is, diminutive but not deformed. Dwarfism (chondrodystrophia fetalis) is a condition of abnormal fetal development of cartilage. It occurs in lower animals also. The most probable theory of its etiology is that of Jansen, i.e., that a small amnion increases the normal embryonic infolding and hydrostatic pressure during the fifth or sixth week of fetal life, resulting in feebleness of growth of the rapidly growing cartilage cells. The cardinal sign is the disproportion between the normal length of body and the short extremities. There is an excess of skin and fat in folds, "pugnose," and the hands are short and chubby with fingers of nearly equal length coming off the metacarpals like spokes of a wheel. Prominent abdomen and exaggerated lumbar lordosis are almost constant. The roentgenologic evidence is most marked in the epihyses and epiphyseal cartilages, especially of the long bones. The periosteum seems to show no change.

In conclusion we desire to express our sincere thanks to Dr. John L. Porter for his kindness in permitting us to report this case and for his helpful suggestions in its treatment and supervision.

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DISCUSSION

Dr. L. T. LeWald, New York. Dr. Stockton, Professor of Anatomy of Cornell, brings out the point that for certain individuals this type of stature and conformation is just as natural as a pug dog is for his species. Stockton says that there is no question that a complete race of individuals of this type could easily be produced.

I think the point is well brought out that these individuals may suffer from deformities and disease, just the same as any other individual, and one must not overlook the correction of the deformity in an individual of this type.

Dr. P. M. Hickey, Ann Arbor, Mich. I was very much interested in this subject. We have recently had a case of pregnancy which was allowed to go on to the sixth month. It was in the service of our obstetrical department, and the case was roentgenographed several times from the standpoint of obtaining the position of the fetus, but at the same time we had ample opportunity to make studies of the long bones. It was exactly of the type that the doctor has described, and the pregnancy had to be interrupted at the sixth month.

Dr. Lewin (closing). There is such a thing as racial dwarfism. In one of the classifications that I did not read, Gilford mentions the racial and the phylogenetic dwarfs.

The point that Dr. Hickey brought out is very interesting. I would be interested in seeing the position of that fetus. Mürk Jansen believed that the amnion, being small, enhanced the normal infolding of the embryo, and that this occurred between the fifth and sixth week of intrauterine life. It was just at that time that these cartilage cells had their most rapidly growing period, and he believes it was just at that time that the increase of hydrostatic pressure squeezing blood out of these cells, caused this condition.

Concerning heredity, Jansen shows many series of entire families, showing that the first child seemed normal, but that farther along, to the seventh or eighth child, when the mother probably had been exhausted, she gave birth to a child that had this condition. I have never seen or heard of two real dwarfs in the same family, although it undoubtedly does occur. There are some cases where the thyroid is involved, and those are the cretinoid types. The cretinoid is a very definite type of dwarf, but I believe there are some in whom the thyroid shows no evidence of any disturbance.

Note. All the cases reported in this article were illustrated by lantern slides, but it has been found impracticable to reproduce them here.

Passing for a moment into the domain of Pathological Anatomy, *we find the same elements in morbid growths that we have met with in normal structures. The pus-corpuscle and the white blood-corpuscle can only be distinguished by tracing them to their origin. A frequent form of so-called malignant disease proves to be only a collection of altered epithelium-cells. Even cancer itself has no specific anatomical element, and the diagnosis of a cancerous tumor by the microscope, though tolerably sure under the eye of an expert, is based upon accidental, and not essential points—the crowding together of the elements, the size of the cell-nuclei, and similar variable characters.* From Border Lines of Knowledge in Some Provinces of Medical Science by Oliver Wendell Holmes.

SOME OF THE PITFALLS IN THE ROENTGENOGRAPHIC DIAGNOSIS OF COLONIC LESIONS WITH SUGGESTIONS AS TO THE PROPER METHOD OF OVERCOMING THEM*

BY W. H. STEWART, M.D.

NEW YORK CITY

THE universal conclusion that abnormalities of the colon can be easily recognized by the roentgen ray and that they do not require the attention given to the upper portion of the gastrointestinal tract, has proven erroneous. The usual roentgenograms before and after defecation following the filling of the colon with an opaque medium are not sufficient in many cases to reveal the lesion.

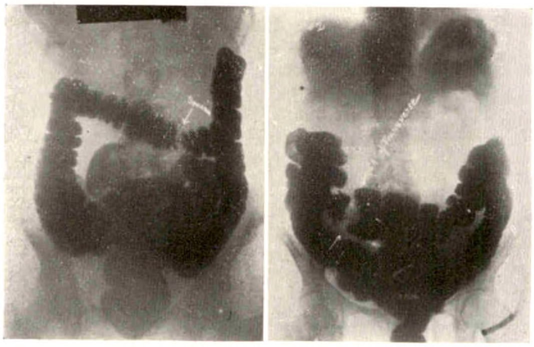

FIG. 1*a*. Defect in the transverse colon due to spasm. *b*. Defect in transverse colon due to Ca. Both cases proved at operation. The cause of the spasm seen in *a* was a chronic appendicitis.

The common errors which one meets in the roentgen diagnosis of colonic pathology are largely due to:

1. Neglecting to make a preliminary examination before the colon is filled with barium enema.
2. The difficulty in differentiating spasm from true pathology (Fig. 1).
3. The overshadowing of a lesion between haustral contractions by a distended colon (Fig. 2).
4. Filling defects caused by intestinal contents (Fig. 4).
5. The variance in the findings at different stages of filling (Figs. 4 and 5).
6. Overlooking the pathology on account of the extreme mobility of the lesion (Fig. 6).
7. Overshadowing by the barium enema of a lesion within the lumen of the colon which has produced no deformity.

It is with the hope of overcoming these errors that the writer ventures to suggest certain improvements in technique.

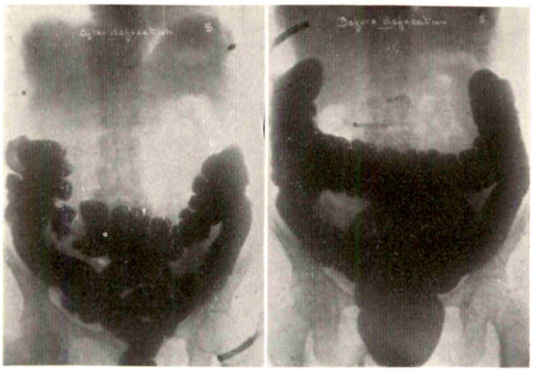

FIG. 2*a*. Defect in transverse colon due to Ca. seen in film taken after defecating part of the clysma. *b*. Colon of same case after distention with barium clysma. Note how the distended haustral folds overshadow the lesion.

Each case must receive individual attention, the roentgenologist being familiar with the history and clinical findings before the roentgen examination is made. The patient must first be thoroughly prepared, usually by administration of mild laxatives, such as compound licorice powder, given when possible the second and third nights before the examination. No cathartic, however, should be administered on the night before, as artificially stimulated peristalsis and spasm is to be avoided. On the day before, the diet should be restricted to soft, easily digested food having little intestinal residue. On the morning of the examination a colon irrigation of clear warm water is given, and repeated, if necessary, until the return flow is clear. Soap enemas should not be used. Dr. Hayes of New York has called our attention to the irritating properties of these solutions; they are likely to occasion resistance and spasm and to interfere with the use of the diagnostic enema.

Care should be taken that the temperature of the examining room be at least 70°F. Chilled skin surface is not favorable to comfort, peace of mind, and perfect relaxation—all essentials.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

When the patient arrives he is placed directly on the roentgenographic table

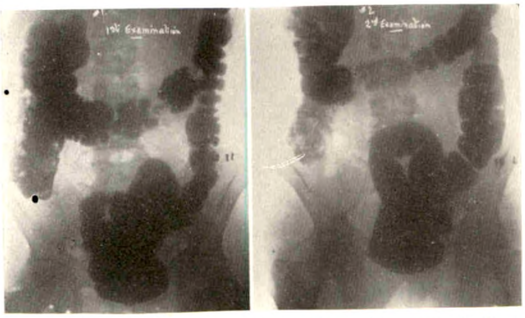

FIG. 3*a*. Persistent defect in outline of cecum. *b*. Same defect at second examination made four days later. Deformity believed to be due to retained intestinal contents, as a normal empty cecum was found at operation.

and a preliminary roentgenogram of his entire abdomen is made. This will avoid the error of overlooking any possible lesion which might be overshadowed by the barium enema such as nephrolithiasis or fecaliths. He is then transferred to

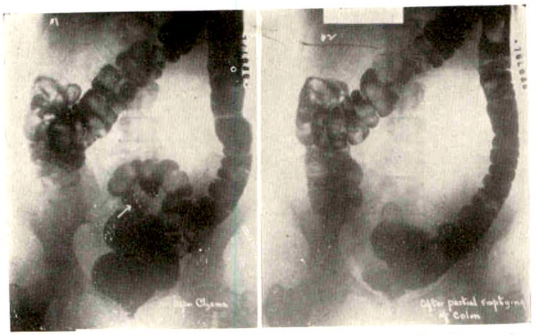

FIG. 5*a*. Colon after barium clysma; full distention brings out the defect indicating the lesion. *b*. In the partial collapse of the large intestine following partial defecation the evidence of the pathology disappears; the reverse of the case shown in Figure 4.

the horizontal roentgenoscope and the method of the proposed examination explained so that he will recognize what is about to take place. It is absolutely necessary to gain the patient's confidence, because his non-resistance will greatly aid in the procedure.

After thoroughly lubricating the anus, with the patient lying on the left side, a rectal tube, also lubricated and having a large opening at the end, is gently inserted into the rectum for 3 or 4 inches. Care should be taken to avoid any sensitive

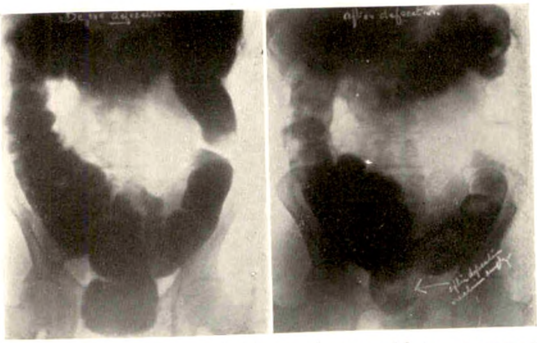

FIG. 4*a*. Colon after barium clysma. Note apparent normal ampulla. *b*. Same case after partially defecating the clysma. Note defect in ampulla indicating Ca.

hemorrhoids. The introduction of the tube should not be done blindly, but after deliberate exposure of the anus by separating the buttocks under sufficient illumination. I know of no one thing that will destroy the confidence of a patient more than to have a nurse or doctor poking

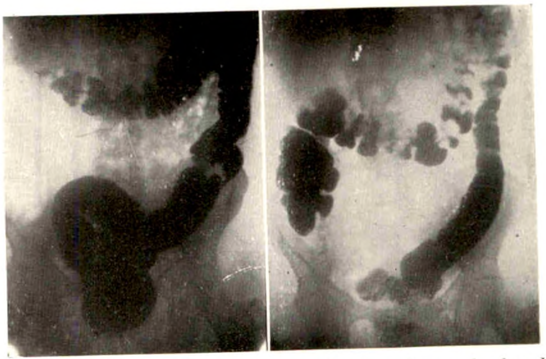

FIG. 6*a* Note defect in colon outline at about the level of left crest; this defect indicates a carcinoma. *b*. After defecation. The patient's effort at defecating the clysma empties the colon distal to the lesion. Note that the defect seen at the pelvic brim is now well in the pelvis indicating free motility. The case on this account is favorable for surgical relief.

around blindly with a rectal tube before the anus is reached. After the tube has been properly passed, the patient is requested to turn gently on his back, the tube being supported while the movement is made. Before the rectal tube is inserted it has been connected with the rubber tubing, generous in length, extending from an ordinary irrigating can which contains the enema. The latter consists of 4 oz. of barium suspended in 500 c.c. of mucilage of acacia mixed with 500 c.c. of hot water.

Before proceeding, two precautions are necessary:

(1) That all the air has been expelled from the entire length of the tube before it is inserted into the rectum. To force air into the rectum ahead of the enema is most distressing to the patient and may defeat the entire procedure.

(2) That the irrigating can is not suspended more than 9 in. above the level of the anterior abdominal wall. The usual custom of elevating the irrigating can to such a height that the opaque medium rushes into the colon, is to be avoided; spasm and distress are the results.

The nurse is then stationed in such a position that she does not interfere with the roentgenoscopist, but where she still has control over the clamp on the tube. The screen is placed on the abdomen and the room darkened. After waiting a full five minutes for the eyes to become accommodated, the examiner notes on the screen whether the tube has been properly placed in the rectum, and the nurse assures herself that there are no kinks in the tube and that there is no obstructive outside pressure. At the signal from the observer the solution is allowed to flow gently until the ampulla is filled, observations being made as this occurs. If the case is one suspected of a lesion in the lower bowel and the observer is not convinced of a normal outline, the can may be lowered and a portion of the enema allowed to flow back; raising the can to the original height the observer may again witness the filling. At this point it is well to assure the patient that should he have excessive pain or desire for stool the injection will be stopped until the spasm is relieved. Usually there is some slight delay after the ampulla has filled, but suddenly, after the sigmoid has unfolded, the opaque mixture shoots up the descending colon; in fact if the operator does not watch closely, he will lose the ascent and may miss the lesion, especially if it is not obstructive. The barium enema is now allowed to flow in gently under the constant eye of the observer until it reaches the cecum; which usually takes about five minutes. The moment the cecum is filled the injection should be stopped. The reason we so often see patency of the ileocecal valve is largely due to an excessive amount of opaque solution injected into the colon. During this filling, if there is an unusual delay at any portion of the large intestine, one should wait a moment to be sure it is not due to spasm; at the same time the intestines can be gently manipulated under the screen by the gloved hand or by a wooden spoon, and fixed points or deformities detected. A mark is made on the skin locating the lesion which has been observed. The light is then turned on and the tube removed. The patient is now transferred to the roentgenographic table and a series of roentgenograms quickly made, especially covering the marked area. One should not depend on one film for record but should verify his roentgenoscopic findings by a series of films which should correspond in number to those usually made of the stomach. If the patient is retaining the enema without distress a stereoscopic pair of films of the entire colon should be made. The patient is then instructed to expel a moderate amount of the enema after which another series of films is taken. He is then allowed to empty the colon as completely as possible, when further films are taken, followed by a final roentgenoscopic examination.

In many instances it is advisable to confirm the findings made with the enema by observations following the barium meal.

The use of a combined roentgenoscopic and roentgenographic table is a great advantage in the examination of these cases. The disturbance to the patient in the transfer from one table to another may defeat the procedure, especially where it is necessary to have the enema retained for any length of time.

In cases in which the lesion is within the lumen of the colon without producing deformity, the barium enema overshadows the growth so that it cannot be recognized by the ordinary methods of examination. Lesions in such cases can be detected by a method suggested by Dr. A. W. Fischer of Frankfurt, Germany. He first gives the patient a moderate amount of barium enema, followed by further colonic distention with air, both of which are administered under roentgenoscopic control. If the suspected growth involves the transverse or pelvic colon, the patient is allowed to expel a portion of the enema before the air is injected. With this method it has been found that the most satisfactory information can be obtained in the lateral positions.

When all other methods fail to give the desired information we may finally resort to pneumoperitoneum.

THE ROENTGENOLOGICAL DIAGNOSIS OF CRANIOPHARYNGEAL POUCH TUMORS*

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A very common situation for intracranial tumors is the region in and about the pituitary fossa. The pure pituitary tumors are usually adenomatous, sometimes cystic, more often solid, and lie within the pituitary fossa, largely distending it. The roentgen appearances brought about by this condition are well known, for the fossa may be hollowed out to an astonishing size, and indeed its posterior clinoid process may become completely absorbed.

Other tumors in this situation may produce the same local syndrome of optic atrophy and changes in the fields of vision. The sella may or may not be deformed and the preoperative pathological diagnosis may be very difficult. However, the nature of one of these lesions may be betrayed by the appearance of calcareous shadows. The object of this paper is largely a discussion of this particular point.

These tumors, which so often cast shadows due to calcification, have been much written about and are commonly known as "craniopharyngeal pouch tumors" or "suprasellar cysts."[1,2,3]

INCIDENCE

The numerical relation of these tumors to other tumors in the neighborhood may be roughly estimated from the following table, representing 253 verified tumors observed in this clinic in this particular anatomical region.

	Number of cases	Percentage of 253 verified tumors	Percentage of all verified tumors in this clinic (930 cases)
Pituitary adenomas	180	71.1	19.3
Pharyngeal pouch tumors	46	18.2	4.9
Meningiomas	12	4.7	1.3
Gliomas (optic chiasm)	8	3.1	.8
Teratomas	5	2.0	.5
Cholesteatomas	2	0.9	.2

It must be realized that these figures are by no means exact, for the primary tumors of the optic chiasm have only recently been described by Martin and Cushing.[4] The meningiomas also are in all probability more numerous than given in this table. Although pituitary adenomas unquestionably are the most common lesion, they have an undue prominence in the table, for the reason that only in the last seven or eight years have transfrontal exploratory operations become common in this clinic, and so histological verification of the craniopharyngeal pouch tumors made possible. Also there is a group of "pituitary tumors, unverified," in which there are several unquestioned craniopharyngeal pouch tumors showing the characteristic calcification, but the patients have not been operated on either because the lesion was in a quiescent stage or because they already had complete blindness.

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* Read at the Fifth Annual Meeting of the Eastern Section of The American Roentgen Ray Society, Atlantic City, N. J., Jan. 24-26, 1924.

PATHOLOGY

The pathology of these tumors is well known. They arise from the pharyngeal pouch (Rathke's pouch) which forms the anterior lobe of the pituitary gland and, being congenital, are found most frequently in young people, the average age being twenty-two and two-tenths, the oldest fifty-seven and the youngest five.

These tumors vary in size from 2 to 8 cm. in diameter and consist of solid and cystic portions. Gross calcareous nodules are seen, especially in the smaller solid nodule, which microscopically is composed of masses and columns of epithe-

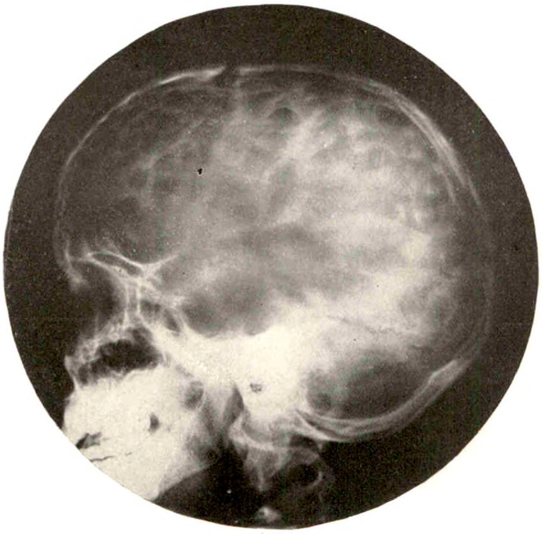

Fig. 1. Case 17235, illustrating marked deformity of the sella and extreme degree of convolutional atrophy due to increased intracranial pressure. Calcification faintly visible directly above sella.

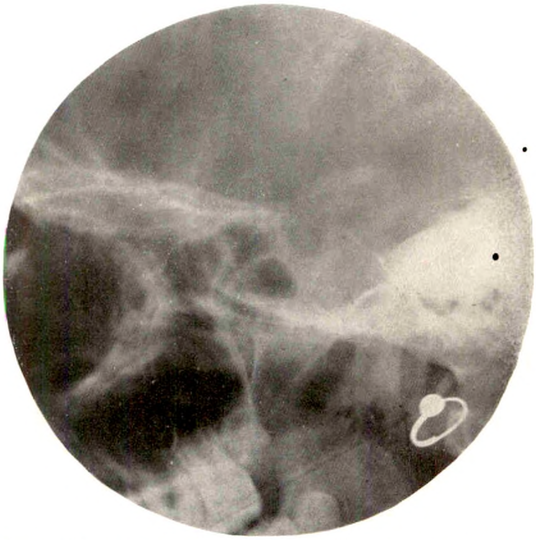

Fig. 2. Case 2990, showing a small, normal sella with dense calcification above the posterior clinoids.

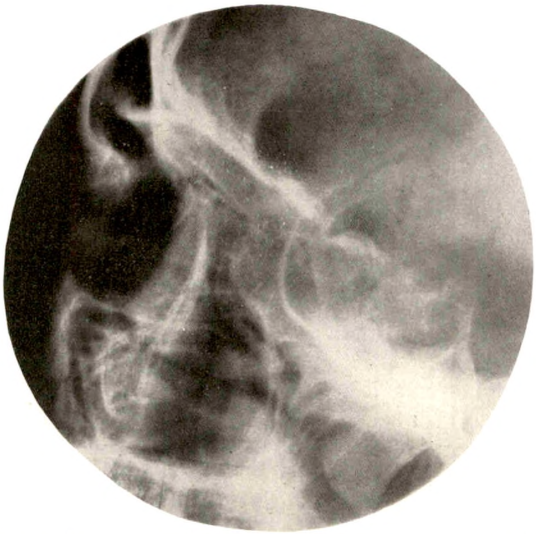

Fig. 3. Case 1345, showing a moderately enlarged sella with dense calcification inside the pituitary fossa.

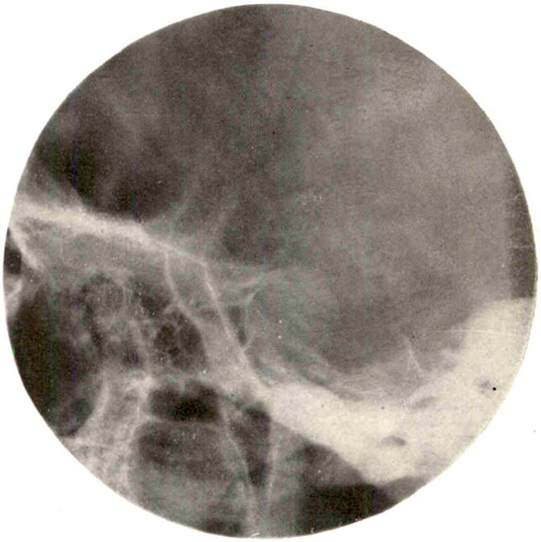

Fig. 4. Case 4345, showing a markedly enlarged sella with erosion of anterior and posterior clinoids, quite similar to that seen in pituitary adenoma. Calcification faintly visible above pituitary fossa.

lial cells, identical in structure with those of the buccal epithelium. The cells may or may not be keratinized; intercellular bridges and intracellular fibrillae are often seen, and pearl formation is common. There is a certain amount of connective tissue stroma, often showing mucoid degeneration. Calcium deposits are found within the epithelial cells. The cyst portion, which usually contains a characteristic golden syrupy fluid with glistening cholesterin crystals and epithelial debris, may be single or multilocular. Small calcareous nodules not larger than a pin-head may be scattered throughout the wall, which consists of a mass of fibrillae and is fairly tough and resistant.

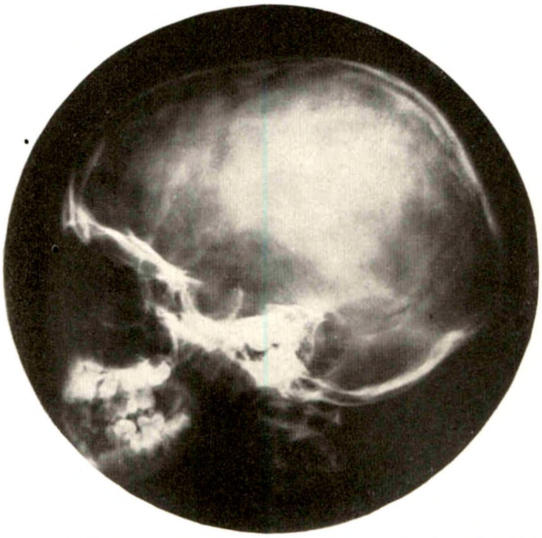

FIG. 5. Case 26941, also illustrating marked deformity of the pituitary fossa with thinning of the clinoids as in pituitary adenoma. Calcification too faint to be reproduced.

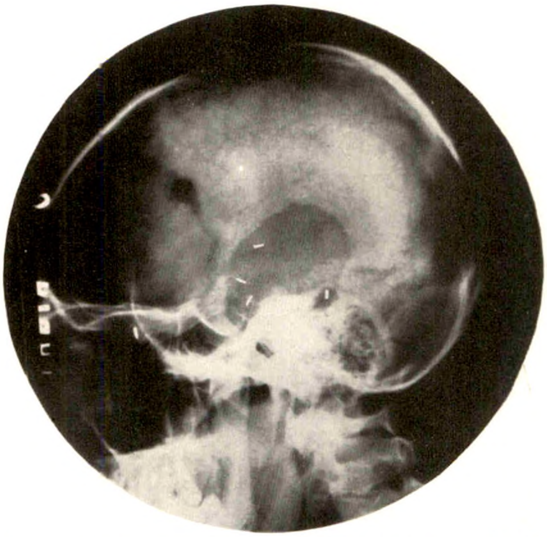

FIG. 6. Case 20316, showing a slightly deformed sella with faint spongy calcification directly above it. A typical case.

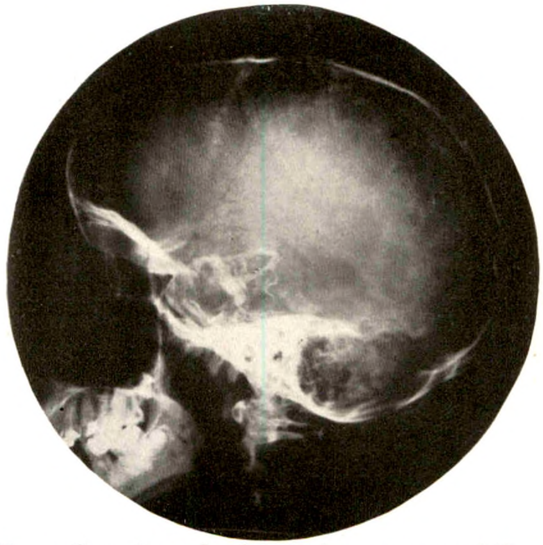

FIG. 7. Case 26993, showing the dense, spongy calcification above the pituitary fossa. The strand-like formations are unusual. Pituitary fossa considerably enlarged and deformed.

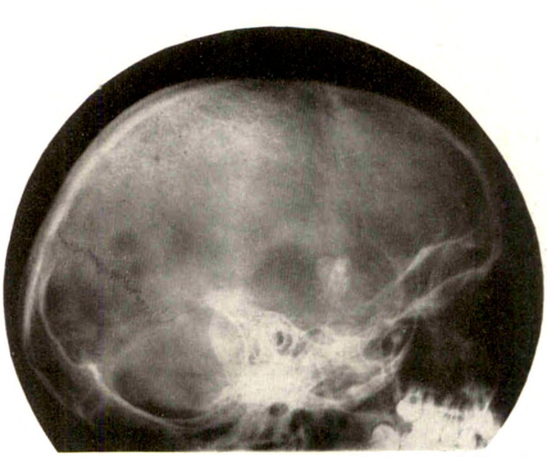

FIG. 8. Case 16629, a typical case. Moderate deformity of sella with a spongy, calcified mass directly above it.

Duffy[3] has described a cystic papillomatous tumor lined with columnar epithelium, which he believes arises from Rathke's cleft in the pituitary gland. In none of the tumors seen here could columnar epithelium be found.

SYMPTOMATOLOGY

Patients with craniopharyngeal pouch tumors, practically without exception, report because of increasing defect in vision. The main subjective and objective findings are conveniently grouped under two headings:

I. *Neighborhood*
  1. Primary atrophy, resulting from direct pressure on the optic chiasm and nerves. The lateral portions usually escape for a time and so a bitemporal visual field defect is found.
  2. Bitemporal headaches and a feeling of discomfort behind the eyes.
  3. Positive roentgen-ray findings, discussed in detail later.

II. *Glandular*

The evidence of glandular disturbance in older patients is often negligible. In the young a fairly typical picture of dyspituitarism is usually seen, consisting essentially of non-development of the sexual organs, dwarfism, and a lowered metabolism. Mentally they are alert and even precocious.

The diagnosis is occasionally quite confusing. Bailey[5] has reported from this clinic 2 cases which gave the typical signs and symptoms of a cerebellar tumor. In one of these the correct diagnosis was made entirely on the presence of calcification above the sella.

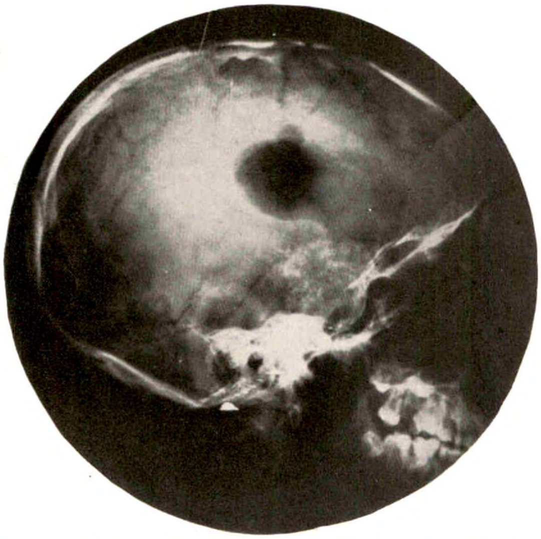

FIG. 9. Case 27119, illustrates relative size of cyst (filled with air) and solid portion which is calcified.

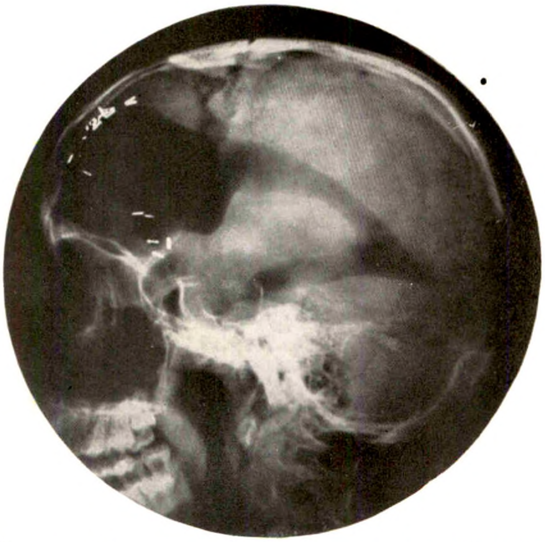

FIG. 10. Case 24137, shows huge cyst occupying the frontal area and communicating with the anterior horn of the ventricle. Calcification small in amount and situated on a level with the clinoids.

ROENTGEN-RAY CHARACTERISTICS

In our study of 35 verified cases of craniopharyngeal pouch tumors, 71 per cent showed the characteristic calcification, which is delicate and spongy in appearance, irregular in formation and not outlining in any of our cases a section of the cyst wall, as in intracranial aneurysms or dermoids. This is due to the fact that the calcification is nodular in character, occuring chiefly in the solid part of the tumor. As shown on the films, it may vary in size from a few faint specks to a mass 8 cm. in diameter. In the majority of cases, the shadows are seen in the midline, either directly above the sella or over the anterior clinoids. In 2 cases only were they located within the fossa.

The outline of the sella was abnormal in 27 cases, or 76 per cent, this abnormality usually consisting in enlargement of the fossa with irregularity and "depression" of the floor. (Dr. Cushing has suggested that this apparent depression of the floor with more or less obliteration of the sphenoid sinus may be due to a maldevelopment of the sphenoid bone, associated with these congenital tumors.) There was destruction in 26 cases, frequently limited to the posterior clinoids, but varying in degree. Generalized pressure, as evidenced by the convolutional atrophy, was present in 17 cases, and extremely marked in 4. One case, not included, was reported as a suprasellar cyst but was found at operation, to be an adenoma, the apparent "calcification" being fragments of the clinoids lifted up by the expanding tumor.

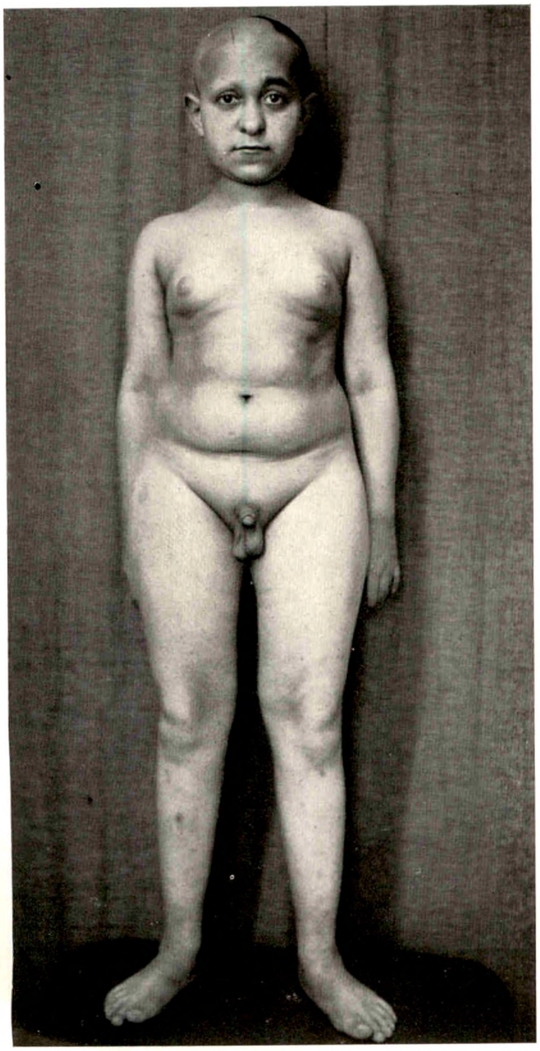

Fig. 11. Case 27119 (see Fig. 9). Photograph of patient aged sixteen showing adiposo-genital dystrophy (hypopituitarism).

ROENTGENOGRAPHIC TECHNIQUE

The technique varies but little from that which is standard in most laboratories. We use a fine focus radiator tube at 22 in. distance, with a 4½ to 5 in. gap and take all skulls stereoscopically on the Potter-Bucky diaphragm. In few instances A.P. or P.A. films are made, but in the majority of cases this is unnecessary. Double screens are used with super-speed films and particular attention is paid to immobilization. The films are exposed and developed so that the soft tissues are obliterated, giving the appearance of a moderately over-exposed film. This is necessary to get the detail of calcification above the sella, which is often lost in the shadow of the cranial vault on "lighter" films.

TREATMENT

Treatment offers very little for the glandular disturbance, and so narrows down to the saving of vision by removal of pressure on the optic chiasm and nerves. It is essential that if anything is to be done for these patients, operation must be performed before there is complete loss of vision.

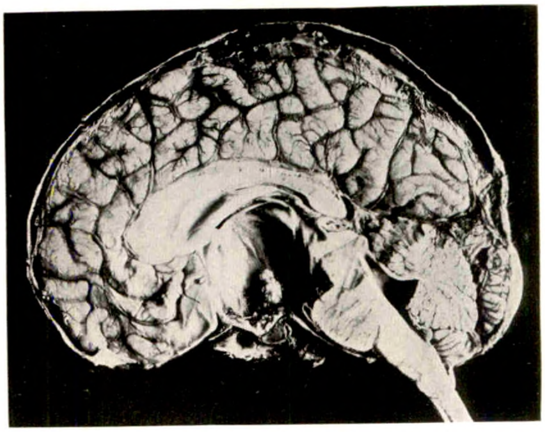

Fig. 12. Case 993, sagittal section of brain showing cyst formation just inferior to the third ventricle with papillary ingrowth containing calcium.

There are two operative routes followed in this clinic for pituitary cases.

1. The transfrontal, in which a frontal bone-flap is turned back, the frontal lobe elevated and the sellar region thus exposed.

2. The transphenoidal, in which the floor of the pituitary fossa is removed from below, through the sphenoid sinus.

The route chosen depends not only upon the pathology, but also upon the architecture of the sella and the age of the patient. The route of choice in craniopharyngeal pouch tumors is the transfrontal. The establishment of the pre-operative diagnosis is important in deciding the route. In several of the cases seen here, the age of the patient and the architecture of the sella were such that a transphenoidal operation might have been performed if it had not been for the tell-tale calcification.

SUMMARY

The roentgen plates of 35 cases of verified suprasellar cysts have been studied. A positive, correct diagnosis could be made in 25 from the pathognomonic calcification. Five were frankly negative and 5 were doubtful.

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The authors wish to take this opportunity to thank Dr. Cushing for permission to study these cases.

METHODS OF IMPROVING THE EXTERNAL APPLICATION OF RADIUM FOR DEEP THERAPY

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RECENT developments of roentgen-ray apparatus and roentgen-ray technique have given this agent the chief place in external radiation in deep therapy. The radium pack, however, has a definite place of its own and should be used in certain cases, as has been pointed out by the writer in a previous article in this Journal.[1]

"Radium pack" is a commonly used term for an applicator containing a number of radium or emanation tubes spread over a large surface, which is placed at a distance from the skin, usually 4 to 10 cm. The pack has been used to a great extent in the United States at places where one gram or more of radium has been available. It has certain advantages over a roentgen-ray machine, viz.: it can be easily transported and used in any room; it can be applied without difficulty to any part of the body; there is no high tension electric current to consider and thus no danger of serious shocks and the absence of the production of ozone and oxides of nitrogen gases; there is no fluctuation in the radiation and thus no uncertainty in the given dose, which can be easily calculated with an error of less than 1 per cent. The physician can apply the pack in a few minutes and the nurse on duty can then look after the patient, as a glance at him now and then is all that is necessary. But, on the other hand, there are also some serious objections to the old-fashioned pack as it has been used during the past.

1. It takes a great distance and long time, with a reasonable amount of radium to get a depth dose comparable to the depth dose from filtered roentgen rays produced by 200 kv.

2. The arrangement for screening undesirable rays is very unsatisfactory and does not give enough protection. The gamma rays spread out in all directions from the tubes. All those which

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[1] Stenstrom, K. W., and Gaylord, H. R. Comparative measurements between radium and x-rays concerning energy absorbed at depth. Am. J. Roentgenol., & Rad. Ther., Jan., 1923, x, 56–62.

do not hit the field on the skin (say 10 × 10 cm.) directly under the pack are of no value in the treatment; on the contrary they often do much harm and ought to be absorbed before they reach the skin. They are, however, very penetrating and it takes about 1 cm. of lead to reduce the intensity to one-half. The pack should, therefore, be surrounded by very heavy lead walls, a condition which cannot be fulfilled with the old-fashioned pack because it rests, as a rule, upon the patient, and, therefore, must not weigh more than a few pounds. Even then, it troubles the patient considerably, as it has to be kept in the same position for several hours. The lead walls, therefore, are usually not more than 2 to 3 mm. thick and consequently the patient gets considerable radiation through these walls outside of the desired field. It also is quite dangerous to handle a large quantity of radium with so little protection. The physician who has to apply the pack and the nurse who takes care of the patient are necessarily exposed to a certain extent. I think it is a common experience that nurses who attend to the old-fashioned pack complain of feeling unusually tired all the time. Their blood-counts often show a decrease in the number of leucocytes. Though the drop is usually nothing serious, it is distinct, and evidently is due to too much exposure, as the blood picture quickly returns to normal as soon as the nurse stays away from the pack.

3. The distribution of the gamma-rays inside the body is poor. Each individual radium tube or container is, with full strength, radiating the whole field, and the rays thus spread out into a cone or pyramid of wide angle, so that the tumor gets only a part of the energy absorbed by the whole body. This is a very serious objection to the old-fashioned pack, as the poisoning of the system from broken-down cells, the effect on the blood, etc., is proportional to the total amount of radiation absorbed, while the good effect seems to depend only upon the amount absorbed by the tumor itself and the immediately surrounding tissue. This objection is still more pronounced if we consider that the total skin area outside the field receives more radiation than the field itself.

All these objections against the old-fashioned pack are directed entirely against the poor and primitive way in which the radium is applied. I will now discuss in a general way the principles we must follow in order to overcome these objections, and will then describe the pack we have constructed and are now using at the State Institute.

It is evident from the above discussion that the applicator must be made very heavy. It is necessary, therefore, to attach it to a stand of some sort. It must, of course, be attached in such a way that it can be easily applied in any direction to any part of the body. Its weight does not need to be further considered if such a stand be used. The next question is how to distribute the individual radium containers and how to direct the rays.

Suppose at first, that the whole amount of radium for disposal is concentrated into one small container, and that a tumor 5 cm. under the skin surface, and occupying a volume of 3 × 2 × 2 cm., is to be radiated. Wherever the container is placed, it ought to be screened so that the ray beam is just a little wider than is necessary to take in the whole tumor, or at times a part of it. If only one field is used the container should, of course, be put directly over the tumor (Fig. 1).

The farther away the pack, the greater is the amount of energy absorbed by the tumor per erythema skin dose. Suppose that E is this tumor-dose and that it is given in the time, T, when the tube is 2 cm. away from the skin. The maximum tumor-dose and the required time when the tube is farther away, can then be calculated approximately with help of the inverse square distance law. For example, if the tube is at a very great distance (1 meter or more) the dose will be very close to $\frac{(5 + 2)^2}{2^2} \times E$, or 12.25 E, while the time will be intolerably long (at 1 m. distance $\frac{100^2}{2^2} \times T = 2500\,T$). At 3 cm. distance the approximate dose will be 12.25 E ×

$\frac{3^2}{(5+3)^2}$ or 1.7 E, and the time $\frac{3^2}{2^2}$ T or 2.3 T. The general formula for the approximate dose at the distance d cm. is $\frac{(5+2)^2}{2^2} E \times \frac{d^2}{(5+d^2)}$ and for the time: $\frac{d^2}{2^2} \times T$.

The figures in Columns 2 and 3 of Table I have been calculated in this way.

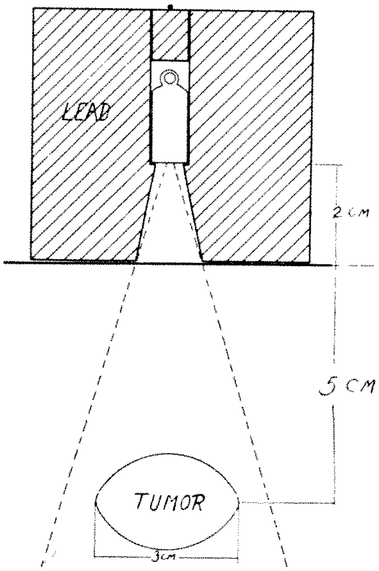

FIG. 1.

TABLE I

Distance from Skin, Cm.	Tumor Dose	Time per Erythema Dose	Time per Dose E. of Tumor
2	1.0 E	1.0 T	1.0 T
3	1.7 E	2.3 T	1.3 T
4	2.4 E	4.0 T	1.7 T
5	3.1 E	6.3 T	2.0 T
6	3.6 E	9.0 T	2.5 T
7	4.2 E	12.3 T	2.9 T
8	4.6 E	16.0 T	3.5 T
10	5.4 E	25.0 T	4.6 T
20	7.8 E	100.0 T	12.8 T

If the container is at a distance of 5 cm. from the skin, then the tumor will absorb 3.1 E. in the time 6.3 T (see table). However, this dose can be given in 3.6 T, or almost half the time with four symmetrical fields and the container at a distance of 2 cm. from the skin, in one following the other of the corners of a square with 5 cm. sides. Four equally strong radium containers can, of course, be used instead in this case if the screening is arranged with care, as is indicated in Figure 2. There are two conditions which we must consider, viz., the field under one tube will receive some rays from the other three tubes. That is the reason why 3.6 T was chosen above instead of 4 T, allowing for 10 per cent of the erythema skin dose through the lead screen. A subcutaneous burn may be produced if the beams from the four containers cross too near the skin. That is why so great a distance between the tubes should be used.

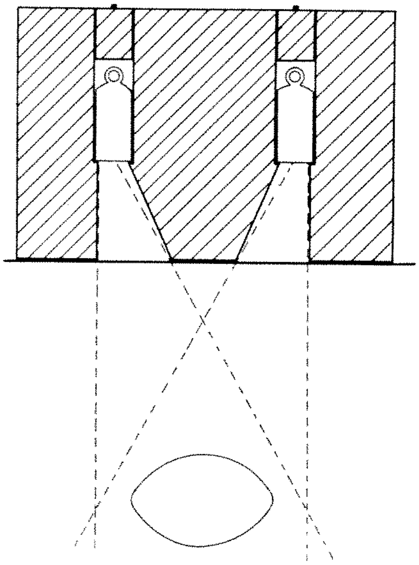

FIG. 2.

It is evident that a greater number of containers can be used in a similar way, and that the screening can be so arranged that the fields on the skin from the different containers do not overlap as they do in the old-fashioned pack, and that there will be no danger of getting a subcutaneous burn. For the sake of convenience, the lead screening carrying the containers should be made in one piece, with each hole of a particular shape, directing the ray beam from each container. Such a lead screen will work as a mechanical lens, and will be referred to, therefore, as the "condenser."

If an unvaried amount of radium salt is to be used at all times, so that the number of the containers and their size and strength are fixed once for all, then it is fairly easy to construct a suitable condenser, but the problem of constructing a condenser which can be used for a varying number of containers of different strengths is more complicated, although more important. This latter problem we will now consider. It is evident that a homogeneous distribution of the rays can only be arrived at if the position of the condenser be changed during the exposure. The simplest way to meet this condition is to make the condenser circular and let it rotate around its axis. The applicators must be distributed along one or more circles of the upper surface of the condenser disc. The distribution of the radiation is dependent upon the diameter and thickness of the condenser, the number of holes in it and the shape of these holes.

It is a general rule that the intensity ought to be as even as possible over the whole field on the skin, in order that the maximum amount of radiation may pass through it. The holes, therefore, should be triangular in shape, the apex of the triangle pointed toward the center of the condenser (A in Fig. 3). If all the holes were alike and of simple triangular shape, all the beams would start to cross one another at one point, producing concentration of radiation in this area. To avoid this, it is necessary to bend off the apices of the triangles to one side, or to split them into two parts, with an edge of lead between (B and C in Fig. 3). A heavy ring-shaped concentration would be produced if all the triangles were bent off in this manner. By combining these two types of holes in a suitable way, the heaviest concentration will take a more cylindrical shape. It would be very difficult to calculate the exact shape of the holes for a certain desired distribution, and it undoubtedly is better to find the final shape and combination of the holes experimentally after an approximate calculation. The photographic method can be conveniently used for determining the distribution of the radiation. This can be changed, if desired, by slight changes in the shape or combination of the holes. Films should be exposed both in the direction of and at right angles to the rays. Figures 4 and 5 illustrate the distribution in a plane through the axis of the condenser (films parallel to rays) when triangular holes only are used. Figure 4 represents fairly large holes. It illustrates how easy it is to get greater intensity at a point inside the body than on the skin and how a subcutaneous burn may be produced from rays which do not leave any mark on the skin. This fact should be a warning against the use of cross-fire without exact calculations.

In accordance with the principles given above, we have recently built a pack at the State Institute which now is in daily use. It consists of three main parts.

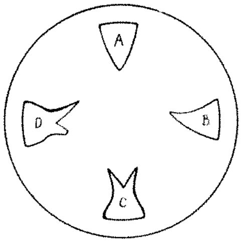

FIG. 3.

1. A cylindrical box of 14 cm. outer diameter and 9 cm. height made of a brass sheet 1 mm. in thickness covered with 1 mm. of aluminum (A in Figs. 6 and 7). The inner wall is lined with lead 1.5 cm. thick. This box hangs in two steel studs which are attached opposite each other to the outside of the wall.

2. The rotating condenser is shown in Figure 6-B (top view) and Figure 7-B (bottom view). The important part of it is the 3 cm. high disc (lead) with its carefully carved holes. On top of this disc is a sheet of brass carrying the emanation containers. Eleven such containers are shown in position in the figure. In the center of the disc is mounted a steel shaft which transmits the rotation. The condenser fits snugly in the box and is balanced on a pivot bearing, so that friction against the bottom is avoided.

3. There is a cover (C in Figs. 6 and 7) which consists of a brass disc 4 mm. thick and 14 cm. in diameter, which can be fastened to the box with bolts and wing

nuts. To this disc is attached a lead disc 2.5 cm. thick, which fits snugly in the box. Through the center is a shaft for transmission of rotation from a motor to the condenser. The lower lead surface is covered with a sheet of brass to which is attached two sheets of fiber.

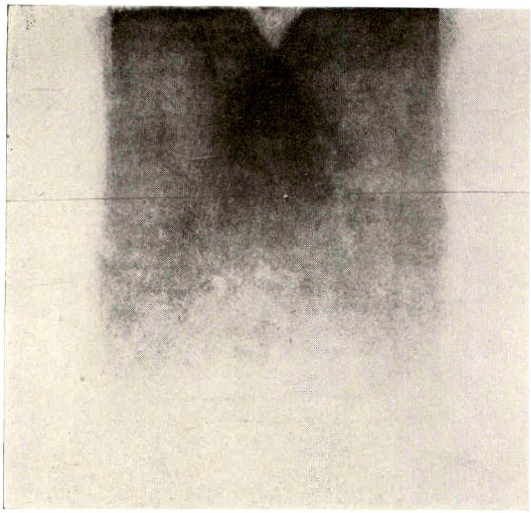
Fig. 4.

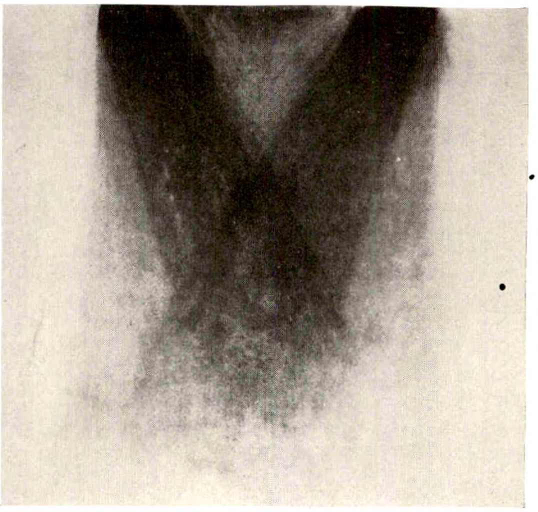
Fig. 5.

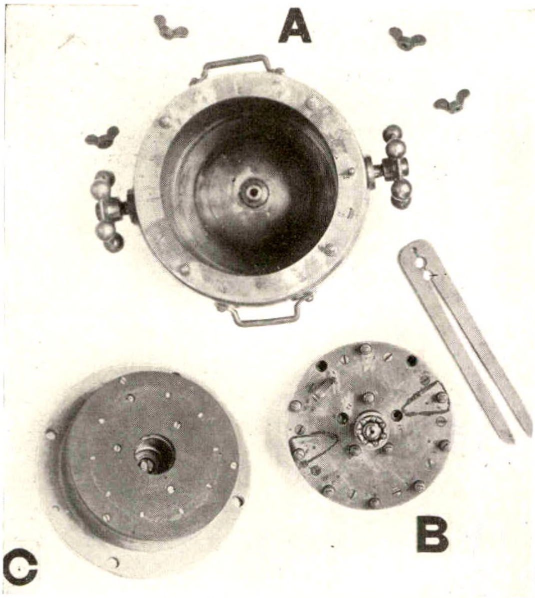

Fig. .6

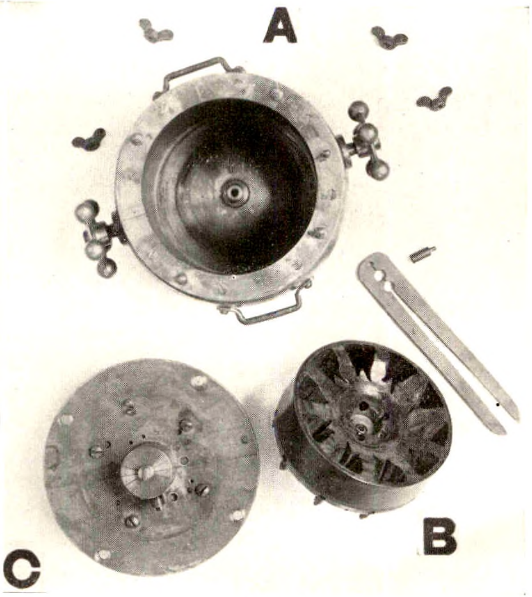

Fig. 7.

The construction of a rotating pack was proposed by Dr. H. R. Gaylord. We are also obliged to E. Pohl for certain advice in connection with the rotation scheme.

An old roentgen-ray tube-stand has been rearranged to make an ideal carrier for this pack (Fig. 8). The former tube-holder has been replaced by a heavy steel bar bent into a semicircle. The bolts in the box fit into slots at the ends of this, so that the pack can be tilted to any angle and fixed with hand nuts. The stand is constructed for all other desired kinds of movements, and therefore it is easy to apply the pack. The rotation is taken care of by an electric motor mounted on the same steel tube that carries the pack, a brass rod with universal joints and the shafts leading through the cover and down to the condenser. Other rotation mechanisms may be substituted, for example, a clockwork mounted on the cover.

It is of great importance that the condenser be kept rotating continuously during the treatment, as a burn may be produced if it is standing still for more than one-tenth of the time. A signal system, therefore, has been combined with the pack which immediately reports if the condenser stops. It is constructed in the following manner: There are placed in the lower fiber sheet attached to the cover some brass buttons, which are connected with a copper wire between the fiber sheets. A brass spring attached to the condenser slides over these buttons, closing a light circuit for a second each time it passes over one of them, thus making signal lamps flash regularly as long as the condenser rotates.

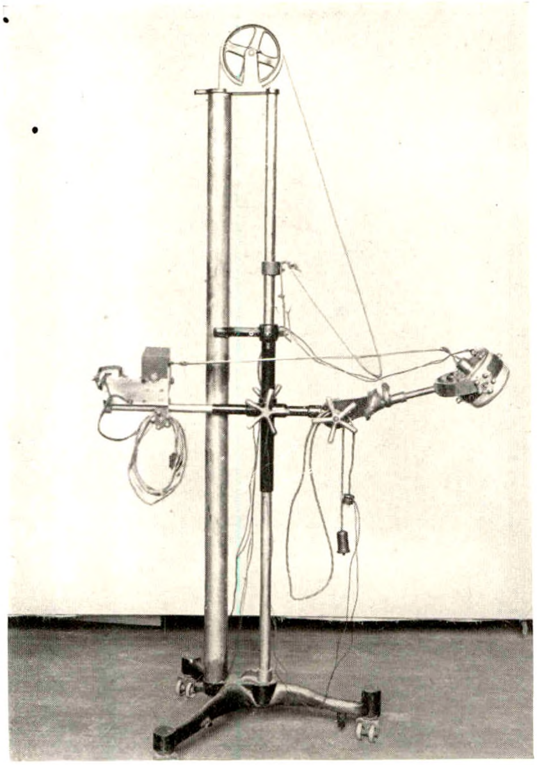

Fig. 8.

The most interesting parts of this pack are, of course, the shape and the distribution of the holes which determine the distribution of the radiation. Figure 9, which is a bottom view of the condenser, demonstrates these graphically. It shows that there are fifteen holes of three different types arranged in two rings. Two holes in the outer ring are of Type A in Figure 3. At the under surface of the condenser these triangles have a height of 2.6 cm. and a base of 2.2 cm. The holes grow narrower toward the upper surface of the condenser where they are circular, and of 6 mm. diameter. Eight holes of the outer ring are of Type D in Figure 3 and of about the same size as the two triangular ones, with a minimum height of 1.9 cm. The five holes in the inner ring are conical with 4 mm. diameter at the top and 6 mm. diameter at the bottom, and the central line is directed against a point about 8 cm. under the pack.

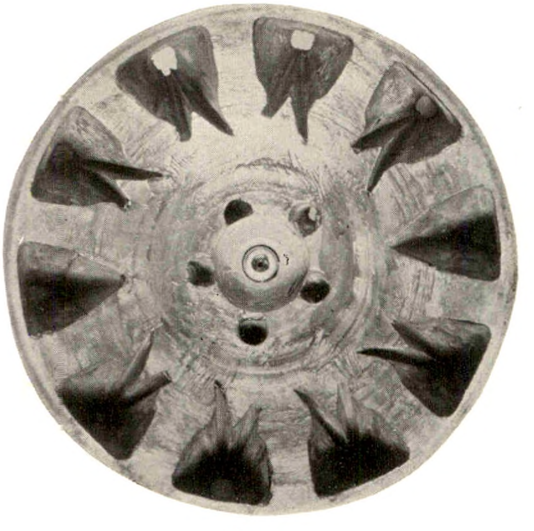

Fig. 9.

These dimensions were obtained through calculation in the following way: (1) The upper diameter of the hole should be approximately equal to the diameter of the bulb (3 to 5 mm.). (2) The width of the hole has been determined so that no overlapping takes place until 1 cm. under the condenser. Ten bulbs have to cover $2\pi \times 5$ cm. at the periphery of the cylinder 1 cm. under the condenser, each one, therefore, 3.14 cm. The are at the bottom of the hole in the condenser, therefore, should be $(3.14. -.16) \times \frac{3}{4}$ cm. = 2.2 cm. (Fig. 10). (3) The rays through the triangular holes should start to meet 3 cm. under the condenser and the height, X, was calculated

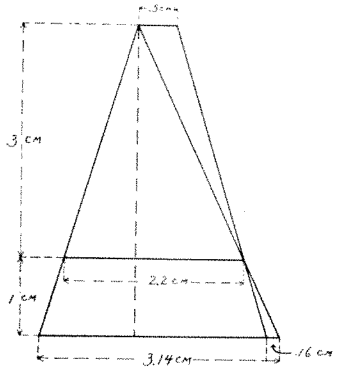

FIG. 10.

from the equation $x/5 = \frac{3}{6}$ (Fig. 11); therefore $X = 2.5$ cm. The rays through the holes of Type D should start to meet in the axis 5 cm. under the condenser and the height Y was calculated from the equation $Y/5 = \frac{3}{8}$; therefore $Y = 1.9$ cm.

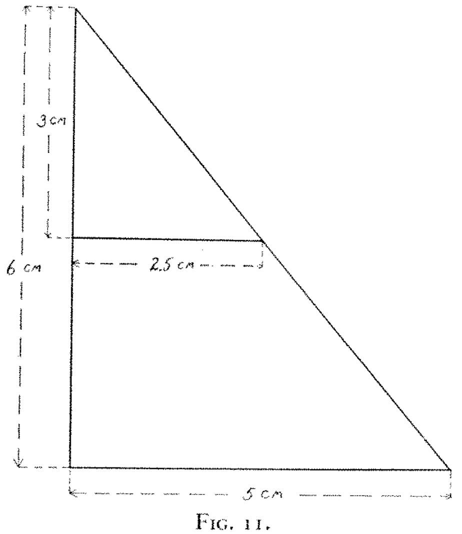

FIG. 11.

It is evident that the emanation should be well concentrated in small glass containers. Ordinary tubes could be used if they were placed vertically above the holes, but bulbs are preferable, as they allow better distribution of the radiation and make easier the concentration of the emanation. We can easily concentrate two days' output from our 2 gm. of radium (about 550 mc.) into one bulb of 3 to 5 mm. diameter. The brass containers used for these bulbs are cylinders of 5 mm. inner diameter with 1 mm. thick wall and bottom, and with covers which screw on. Only fifteen bulbs can be used in the pack, and therefore, we concentrate the emanation from a number of old bulbs into one as soon as we accumulate too many. This is done about once a week in a simple apparatus which has been described before in this Journal.[1]

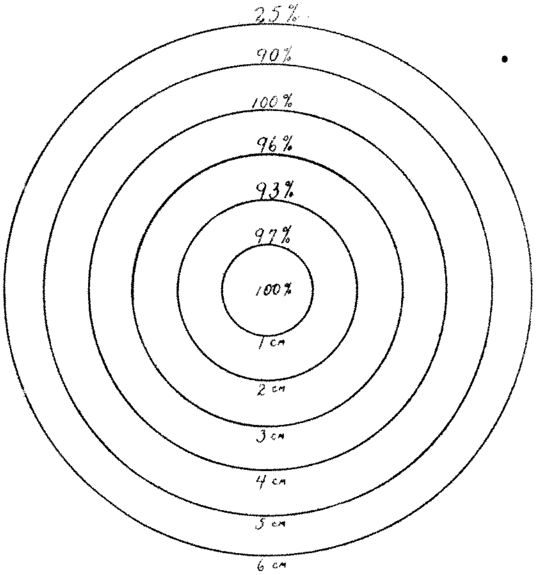

FIG. 12.

The containers fit snugly into holes in the brass disc of the condenser, and each one is kept in position by a little peg pressed against it with a spring. The rays are filtered through 2 mm. of brass (1 mm. at the bottom of the container and 1 mm. at the bottom of the box) and 1 mm. aluminum (at the bottom of the box).

A very good distribution of the radiation is obtained with this pack if 16 per cent of the emanation is put on top of the conical holes, the same amount over the triangular holes and 68 per cent over the other holes. The distribution has been studied with the photographic method and the intensity at different points has been determined in such a way that the time of exposure was varied so that the same blackness, measured with a photometer, was produced at all of these points. If the greatest intensity directly under the pack is called 100, then the distribution at the surface is that of Figure 12. The field is sharply outlined. While the intensity varies between 90 and 100 per cent inside the field, it drops down to 25 per cent in less than 1 cm. outside the edge, and to about 10 per cent in another centimeter.

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[1] STENSTROM, K. W. A new device for retubing radium emanation. AM. J. ROENTGENOL., 1923, X, 311.

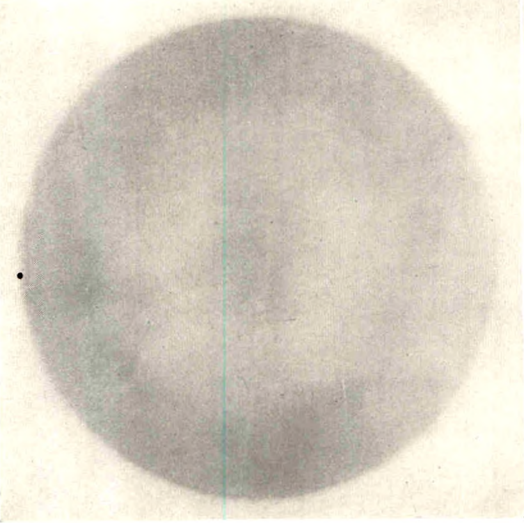

FIG. 13.

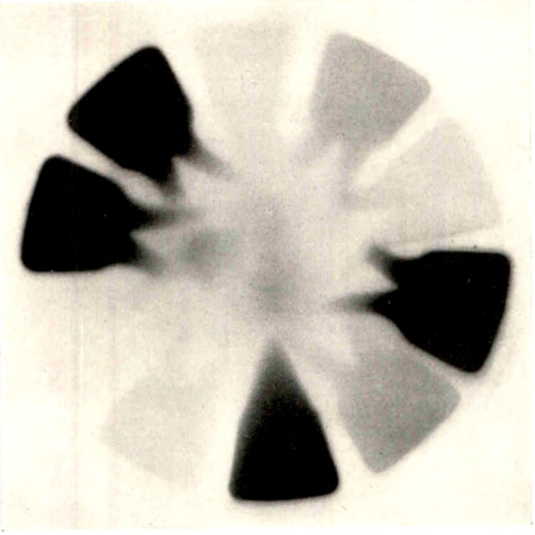

FIG. 14.

Figure 13 shows a film taken while the condenser was rotating, and Figure 14 was taken with the condenser standing still. Both films were placed immediately under the pack on top of a 10 cm. thick cake of wax. The same distribution of emanation was used and the same time of exposure.

Figure 15 shows how a film gets blackened if it is exposed in the center of the field at right angles to the bottom of the pack between two cakes of wax, while Figure 16 gives the distribution of the radiation at depth in percentage of the surface intensity. Figures 17 and 18 are the corresponding exposures with the old-fashioned pack. In comparing these figures it is striking how nicely the rays are being kept inside a cylinder directly under the new pack, while they spread out sideways when using the old pack.

A cylindrical volume of about 5 cm. diameter stretching itself from about 3 cm. to 10 cm. under the bottom of the new pack is especially useful for radiation of tumors. Beneath 10 cm. the rays spread out fairly rapidly.

If another kind of distribution is desired (for example, more concentration at greater

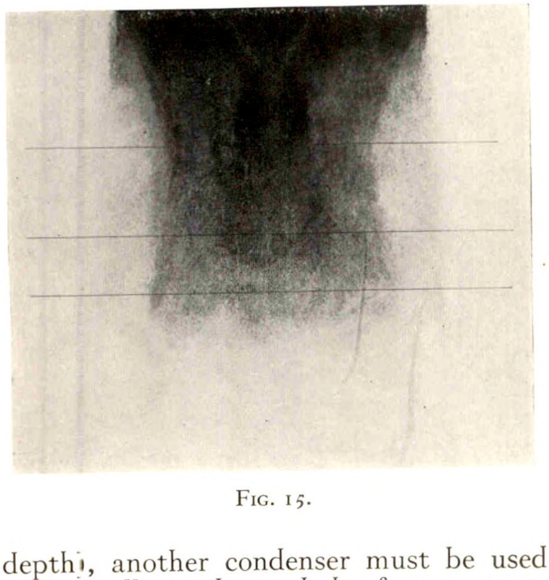

FIG. 15.

depth), another condenser must be used with smaller or larger holes for a concentration deeper down or higher up. If a tumor 2 to 3 cm. under the skin is to be treated, it would be preferable to use a thinner condenser in order to reduce the time for the dose.

It is, of course, necessary to rearrange the containers when a new bulb goes into the pack or when an old one is taken out, in order to get the right proportion of radiation from the different kinds of holes. This routine work is made easier if a simple sketch is made showing the holes numbered as they are in the condenser. The numbers and strengths of the containers are then marked in the sketch where they should be placed. We are now using a rubber stamp with this sketch in order to save time. Figure 19 shows an acceptable arrangement. The outside printed figures are the numbers of the holes, the upper figure at each hole gives the number on the container and the lower figure, the amount in millicuries that it holds. If a constant amount of radium salt is used in the pack, no such routine work has to be done.

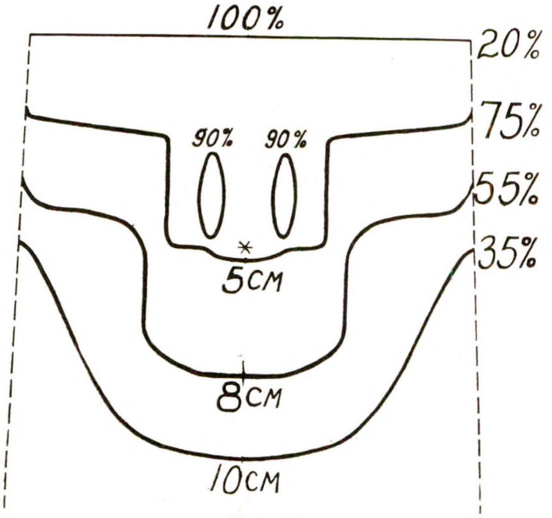

Fig. 16.

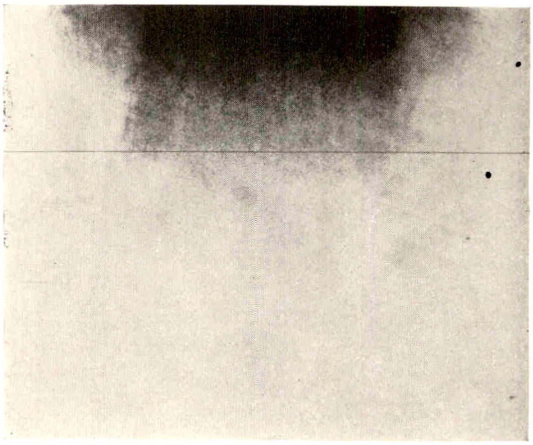

Fig. 17.

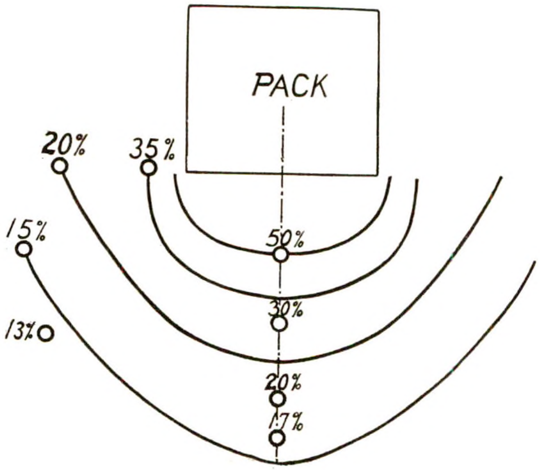

Fig. 18.

The following table gives a comparison between the efficiency of the old pack and the new pack. The filter is for both 2 mm. of brass and 1 mm. of aluminum.

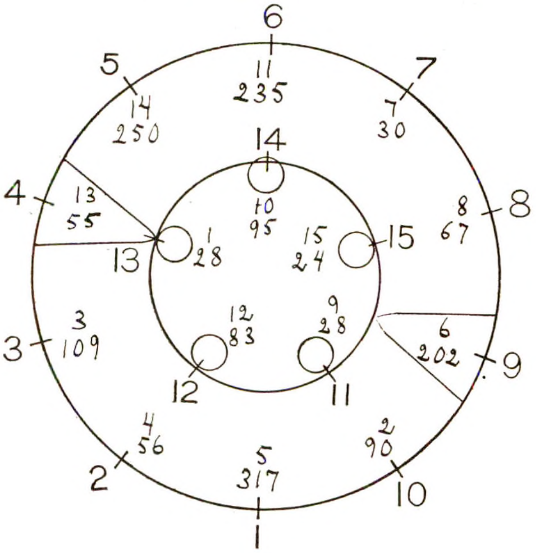

Fig. 19.

Table II

	Distance from Containers to Skin, Cm.	Depth Dose under Skin		Erythema Skin Dose, Gr.-hrs.	Field, Cm².
		5 Cm.	10 Cm.		
Old pack....	6.0	35%	17%	6	40
Old pack....	10.0	....	21%	15	
Old pack....	20.0	....	34%	60	
New pack...	3.3	75%	35%	17	80

The table shows that with approximately the same depth dose the number of gram-hours has been reduced from 60 for the old pack to 17 for the new one, which means that it now costs only about one-fourth of what it did before to get this depth dose of 35 per cent.

For about the same cost a depth dose of 35 per cent is now obtained instead of 21 per cent as before, an increase of more than 50 per cent. It is true that the area of the field is twice as large as it was before and that there was a possibility of using several fields with the old pack at 6 cm. distance. However, a considerable amount of radiation would reach the other fields when one field was radiated, even if the fields were relatively far apart. Therefore, the skin dose on each one would have to be reduced, and the depth dose reached with several fields is far from the depth dose reached with one field multiplied by the number of fields. Furthermore, the amount of radiation absorbed by the whole body would be very great, and four times the erythema dose with the pack at 6 cm. distance will cause a considerable change of the blood picture for most patients.

The greatest advantage of the new pack over the old one is that the amount of radiation absorbed inside a cylinder directly under it is about one-half the total amount absorbed by the body, while for the old pack this relation is of the order 1 to 10.

It is only at hospitals possessing large quantities of radium that packs of this construction can be of value. We keep our pack in use almost continuously day and night with about 1.6 curies emanation in it. It is too early yet to definitely determine the ultimate success in all cases with the new pack, but the results so far are much better than they were with the old pack. However, the time for the erythema skin dose is uncomfortably long (about ten hours) and probably better results could be obtained if 5 to 10 gm. of radium were used.

In the beginning of this article it was pointed out that the old radium pack had certain advantages, and certain disadvantages, as compared to the roentgen-ray tube. The new pack has all the advantages and at the same time is free from most of the disadvantages. It cannot, of course, compete with the roentgen-ray tube in economy, and an enormous quantity of radium is needed in order to produce the same effect in the same time. However, the peculiar distribution of radiation makes this pack more suitable than the roentgen-ray tube in many cases. For instance, a heavy dose can be put into the lower jaw and the tongue from beneath the chin. It will give a good distribution of radiation in the larynx. For certain breast tumors, it is favorable because sensitive surrounding tissues will be saved from heavy radiation. For the same reason metastasis in the axilla can be well attacked with it. The prostate and the vulva also can be radiated with it in a very desirable way.

Radiotherapy is rapidly gaining ground. However, it still is often severely criticized and declared a failure. It is a failure where it is misused, but the many wonderful results which have been obtained prove that rightly used it is a success. Not until we know when and how it ought to be used in order to get good results is the success ours. Many failures are due to the fact that patients are treated with radiation when it is not indicated. A still greater number of failures are dependent upon the fact that radiation is applied in the wrong way. Many patients have been cured or improved with the correct distribution of radiation after unsuccessful treatments with the improper dose. With improved applicators new fields for radiation open up and success may be obtained where it was before impossible to get results. Poor applicators used for radiation are worse than dull knives used for operations.

SUMMARY

The old-fashioned radium pack has certain advantages, but also serious disadvantages as compared to the roentgen-ray tube. Theoretical discussions show that some of these disadvantages are not inherent in radium, but can be eliminated through carefully constructed applicators. The fundamental principles underlying the construction of such applicators have been discussed here.

In accordance with these principles, a new radium emanation pack has been constructed,[1] and has here been described. The illustrations show how it is constructed and how the radiation is distributed, while Table II gives a comparison between it and the old-fashioned pack in regard to some important qualities. The most important advantage it has over the old pack is that the total amount of radiation absorbed by the body is only about twice the amount absorbed directly under the field, while with the old-fashioned pack the amount absorbed by the whole body is many times (say ten times) the amount absorbed directly under the field.

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[1] A short note on this pack has been published in *Proc. of Soc. Exp. Biology & Med.*, 1922, xx, 65. It has been in use since July, 1922. This article was written in the beginning of 1923, but the publication unfortunately has been delayed. A pack with heavy lead screening has recently been described by Burnam and Ward in the AM. J. ROENTGENOL., 1923, x, 625. The principle of cross-firing from the individual tubes is not utilized in their pack nor is even distribution by continuous rotation obtained with it.

It was characteristic of Faraday's devotion to the enlargement of the bounds of human knowledge that on his discovery of magneto-electricity he abandoned the commercial work by which he had added to his small salary, in order to reserve all his energies for research. This financial loss was in part made up later by a pension of £300 a year from the British Government . . .

The discoveries made by Faraday were so numerous, and often demand so detailed a knowledge of chemistry and physics before they can be understood, that it is impossible to attempt to describe or even enumerate them here. Among the most important are the discovery of magneto-electric induction, of the law of electro-chemical decomposition, of the magnetization of light, and of diamagnetism. Round each of these are grouped numbers of derivative but still highly important additions to scientific knowledge, and together they form so vast an achievement as to lead his successor, Tyndall, to say, "Taking him for all and all, I think it will be conceded that Michael Faraday was the greatest experimental philosopher the world has ever seen; and I will add the opinion, that the progress of future research will tend, not to dim or to diminish, but to enhance and glorify the labours of this mighty investigator." From the biography of MICHAEL FARADAY in Harvard Classics, Vol. 30.

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Information of interest to all readers will be found on page vii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

THE RESULTS OF THE EXPERIMENTAL STUDY OF CANCER

The experimental study of cancer has but a short history, yet its accomplishments in explaining some of the mysteries which surround this disease compare favorably with those obtained by the clinical study of human patients. But these phases of study, it must always be remembered, are complementary. Every step which has been made in the experimental study of the general biology of cancer has illuminated some old clinical observation, perhaps forgotten, or has suggested new points for clinical investigation. On the other hand, it must be borne in mind that the study of animal cancer, although it may have a certain general interest, is still primarily merely a convenient method of attack for the ultimate solution of the question in man, and is in itself, therefore, relatively unimportant. No sound vision of the whole problem will ever be reached unless the facts of human cancer are kept always in the foreground.

A complete review of the field of experimental cancer is manifestly impossible, but a few of the outstanding discoveries made by means of animals may be of interest.

One of the first things noticed was the fact that animal tumors, after they had been inoculated into a healthy host, would disappear spontaneously. This was seized upon as pointing toward the possibility of a cure of human cancer, forgetting that in a grafted tumor the host is merely a culture-tube and the tumor not perfectly adapted to the soil in which it grows. Unfortunately the human tumor with one exception, chorionepithelioma, is perfectly adapted to its soil.

These spontaneous disappearances, while they have not led to cure, have called renewed attention to those curious spontaneous cessations of growth which we see in human beings. Sometimes these cessations are long enough to warrant the belief that a true cure is being observed, but usually, if the cases are followed for a number of years, the tumor regains its old vivacity of growth and the patient dies. So, in general, when a human tumor disappears permanently the assumption is justifiable that it was not a cancer.

On the other hand, there are even transplantable mouse tumors with such high virulence that they do not disappear at all, but act in any host as if no restraints existed against their growth.

It was long since shown that no artificial immunity can be produced against a transplanted tumor, once it starts to grow. If the animal chooses to make the tumor's life uncomfortable by refusing it food, that is one thing, but we have no means of influencing this process; hence the doubtfulness of ever being able to treat human tumors with serums or medicines. Certainly nothing which has been produced so far has offered the slightest hope that a solution of the cancer problem in that direction is even on the horizon.

In other directions, the study of animal tumors has strengthened some old beliefs and cast new light upon present problems. For example, the fact that transfusion or injection of blood in an animal carrying a tumor tends, if anything, to increase the growth rate should certainly put a quietus on similar attempts in man.

Yet the daily press teems with notices of new serum cures for cancer. The serum usually enjoys a period of success for about a year, at the expiration of which time, all those who have been treated having died, the cure is abandoned. It is unfortunate that there is no method to compel the test of all cures on animal tumors first: much human suffering would be thus spared.

Again, the study in mice of the influence of massage in the distribution of tumor cells all about the body has called attention to the gravity of the existing situation due to the extensive use throughout the country of massage and manipulative methods for all sorts of disease, including cancer.

The problem of the advisability of a biopsy in suspected cancer, where a diagnosis can be made by no other means, has been clarified by experimental studies.

Finally, the study of the effects upon tumors of various forms of physical energy such as heat, radium or the roentgen ray, has cast much light upon this difficult therapeutic problem and will in the near future no doubt furnish more.

These are the achievements of the past. What about the future?

It would seem that the most important immediate step would be the discovery of some generally applicable means of diagnosis of cancer by some chemical or biological test.

If the growth of the fetus causes changes in the metabolism of the mother it should be expected, and has, in fact, been found, that similar changes occur in the metabolism of animals and human beings bearing tumors. Should these changes be shown to be sufficiently characteristic in the early stages of the disease instead of only in its terminal phase, as we now see them, the present methods of cancer therapy would instantly increase in their range of usefulness, because the great defect in the therapy of to-day is that we are, in such a large proportion of cases, too late.

If such a diagnostic means, no matter how complicated or difficult, can be discovered, then a great step will have been taken and we may await with somewhat less impatience the ultimate though possibly far distant discovery of a medicinal cure.

Francis Carter Wood.

PROPOSED SECTION OF RADIOLOGY OF THE AMERICAN MEDICAL ASSOCIATION

The Council on Scientific Assembly of the American Medical Association, of which Dr. J. Shelton Horsley of Richmond, Va., is Chairman, has recommended that there be two sessions of Radiology under Miscellaneous Topics at the next meeting of the American Medical Association.

Dr. Willis F. Manges of Philadelphia has been appointed Chairman, Dr. Albert Soiland of Los Angeles, Vice-Chairman, and Dr. Maximilian J. Hubeny of Chicago, Secretary.

Further consideration of the formation of a full section in the American Medical Association will undoubtedly depend upon the attendance and enthusiasm shown at these two sessions under Miscellaneous Topics.

There are numerous considerations that make highly desirable the formation of a permanent Section of Radiology in the American Medical Association. Chief among these is the opportunity it would afford for radiologists to come into closer contact with the great body of clinicians in all branches of medical practice.

There seems no doubt that such contact would not only broaden the roentgenologist's outlook and make him much better able to cooperate with his confrères in clinical medicine, but it would obtain for him a hearing by men in all other lines that he cannot hope to secure in meetings confined to men of his own specialty.

The American Medical Association has always been liberal and progressive along sound lines in its recognition of new methods for the diagnosis and treatment of disease. Its recognition of radiology as an integral part of medicine may have seemed somewhat belated to those whose entire lives have been given to the practice of this specialty, but it should be remembered that it is less than thirty years since the roentgen ray was discovered, and that progress has been gradual through these years.

A great opportunity is now offered to roentgenologists and radium therapists to cooperate with the rest of the medical profession, and the officers who have been appointed earnestly solicit the aid and advice of all in order to assure a successful meeting this year.

PEPTIC ULCER AND ROENTGENOTHERAPY

The feeling of enthusiasm in regard to short-wave therapy that swept the medical world after the close of the war has quietly cooled down to a more rational basis. Since then we in this country have been plodding along, establishing to our own satisfaction the most that we can really expect from this form of treatment.

The extravagant claims of the German school have not been entirely borne out. For example, there have appeared in the last two years in German medical literature a number of papers upon the treatment of peptic ulcer. All the authors report about 75 to 85 per cent of cures, some working with single doses and others with divided doses. Both these methods have been thoroughly tried out by us with special attention to technical detail and our results have been almost complete failures. Some of the patients have even been made worse both in subjective and objective symptoms.

We believe that we should be very cautious with so powerful an agent, realizing fully that the possession of a short-wave therapy machine does not give us the moral right to use it indiscriminately.

Ernest C. Samuel.

As we go to press word is received of the sudden death of
Sir Archibald Reid, K. B. E., C. M. G.

Subscribers to The American Journal of Roentgenology and Radium Therapy *visiting New York City, are invited to make the office of* The Journal (69 *East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

ANNUAL MEETING, EASTERN SECTION, AMERICAN ROENTGEN RAY SOCIETY

The Eastern Section of The American Roentgen Ray Society held its fifth annual meeting in Atlantic City on January 24, 25 and 26, 1924, under the chairmanship of Dr. Thomas A. Groover of Washington, and with Dr. W. C. Wescott of Atlantic City as secretary.

The meeting was characterized from beginning to end by unusually enthusiastic discussion of the subjects presented.

It is impracticable at this time to make a complete report of all the papers presented, but the following is a brief résumé of some of the important points emphasized by various contributors to the program.

Discussion of a paper by Drs. Lattin and Perkins on "The Differential Diagnosis of Cardiac Enlargement and Pericarditis with Effusion" brought out a marked difference of opinion regarding the possibility of demonstrating the heart shadow within the pericardial shadow. Several believed this possible, while others thought it not only physically impossible, but that there are other shadows, such as those cast by encapsulated mediastinal collections of fluid which may be present at the same time as pericarditis with effusion, which may stimulate the heart shadow.

Dr. Samuel presented a paper on "The Roentgen Diagnosis of Aneurysm of the Aorta" based upon his extensive experience as roentgenologist for Dr. Rudolf Matas. He stated that he had never been able to demonstrate an aneurysm below the diaphragm, no matter what the type, by the aid of the roentgen ray. He emphasized the importance of careful roentgenoscopic and roentgenographic examination of the aorta of *all* patients in various positions when they are referred for either chest or gastrointestinal examination.

Drs. Thomas and Farmer presented a very comprehensive paper on "The Diagnosis of Primary Intrathoracic Neoplasms" giving a thorough study of cases from the clinical as well as the roentgenologic standpoint.

The paper by Dr. George W. Holmes on "Massive Collapse of the Lung" was based upon a study of 4 such cases at the Massachusetts General Hospital since the case reported from that hospital by Ritvo in 1922. The disease "usually involves an entire lobe and not infrequently the whole of one lung. Symptoms may be present or absent. They may be of extreme urgency or of only moderate severity. In practice, it is most often seen following abdominal operations, especially for hernia and appendicitis. Its cause is not entirely understood but it is frequently accompanied by a partial or complete paralysis of the diaphragm on the affected side." Displacement of the heart to the affected side is a common roentgen finding and this is usually accompanied by a high, rigid diaphragm with increased density in the affected portion of the lung, and by narrowing of the intercostal spaces on the affected side.

Dr. Walton's paper on "Malpositions of the Diaphragm with Report of a Case of Eventration" was an especially clear description of the roentgen appearance in eventration, and is of additional value because of a very complete bibliography accompanying it.

The paper by Dr. Manges on "Atelectasis as a Roentgen-Ray Sign of Foreign Body in the Air Passages" was another contribution out of a unique experience in the study of foreign bodies in the air passages. He emphasized especially the necessity for roentgen study of a suspected case in both inspiration and expiration.

The paper by Dr. Sosman on "The Roentgenological Diagnosis of Craniopharyngeal Pouch Tumors" is published in this issue of the JOURNAL.

Dr. Pfahler's paper on "The Study of the Sternum by the Roentgen Rays" calls attention to a neglected field in roentgenography. He demonstrated the possibility of diagnosing metastasis or direct extension of malignant disease to the sternum from the breast, pleura, or mediastinum.

Dr. Witherbee in a paper on "Roentgen Therapy in Tonsillitis and Pharyngitis," called particular attention to the necessity for treating these cases in the proper positions and at the correct angles.

In a paper on "The Relation of Blood Types to Malignant Disease and The Influence of Radiotherapy" Drs. Pfahler and Widmann give a summary of experimental work on this subject. Their conclusions are as follows:

1. With our present knowledge of the technique of differentiating blood types, we find there is no relation between blood types and malignant disease.
2. The percentages established by Moss, Culpepper, Bernheim and Buchanan are only approximate and capable of considerable variation without particular significance.
3. Individuals of all four blood types are liable to suffer from malignant disease.
4. Individuals of Groups I and III are not more susceptible to malignant disease than others.
5. The type of blood has no relation to the degree of malignancy.
6. Neither radiation, roentgen sickness, nor the evolution of a malignant process, retrogressive or progressive, can alter a blood type.
7. Possibly some future refinement in the study of isohemagglutinins may detect some change heretofore unrecognized.

A paper which gave rise to much discussion was that on "A Case of Hodgkins' Disease, with Late Development of Sacroiliac Disease, Cured by Roentgen Treatment" by Drs. Pfahler and O'Boyle. The case reported had bone involvement in the sacroiliac region following extensive Hodgkins' disease in the chest; the bone lesion disappeared completely under roentgen-ray treatment. In the discussion a number of members reported similar cases.

Drs. Leddy and Weatherwax in a paper on "Palliative Doses of Roentgen Ray in Advanced Cancer" state the following conclusions:

1. Inasmuch as "Erythema," "Carcinoma" and "Sarcoma" doses have no absolute value, dosimetry on a basis of these is an arbitrary technique.
2. In advanced cancer roentgen-radiation with the technique of fractional doses applied at intervals has given satisfactory results.
3. The supposition is advanced that in more favorable cases of carcinoma a similar technique may be as effective as more intensive, radical therapy.

Dr. Quick contributed a paper on "Some Considerations in the Treatment of Carcinoma of the Esophagus," in which he emphasized especially the necessity for an early gastrostomy and early direct examination through the esophagoscope. He gives the following conclusions:

1. Carcinoma of the esophagus is a disease in which we can hope for palliative relief only.
2. An early gastrostomy offers the major portion of this relief.
3. External radiation, preferably with high voltage roentgen-rays, aids in slowing up the rate of tumor growth, but so far has not controlled it.
4. Intra-esophageal application of radium, preferably in small repeated doses, is indicated to control ulceration and bleeding locally, but has little influence on the actual progress of the disease.

Many other interesting and valuable papers were read and discussed. They, as well as those mentioned above, will be published in the JOURNAL within the next few months. The meeting, on the whole, was thought by those in attendance to be one of the most profitable the Society has ever had.

At the concluding session the following officers were elected for the ensuing year: President, Charles Eastmond, Brooklyn, N. Y.; Vice-President, Ralph Leonard, Boston, Mass.; Secretary, Fred M. Hodges, Richmond, Va.

BRITISH INSTITUTE OF RADIOLOGY

The following extracts from a letter from Sir Archibald Reid to Dr. Wm. H. Stewart explaining the organization and objects of the British Institute of Radiology will be of interest to many of our readers: ". . . we hope to make the Institute a central body to act as a clearing house for British Radiology and a central bureau for the collection, correlation and distribution of our radiological activities. The house of the Institute is a suitable one for these purposes and we hope to have it ready to start work in October of this year (1923). We hope to make it useful to our members and also to our colleagues from other countries who may visit us, in providing a convenient place for them to obtain any assistance necessary in carrying out their program.

"It is proposed to form a radiological museum and to equip the library, and it is especially in this connection that we should be grateful to your members for books of reference and reprints of articles, and also skiagrams especially in the form of lantern slides of cases of interest (verified) and of cases where the rarity of the condition makes diagnosis problematical or doubtful. Any assistance of this kind would be very highly appreciated by the Committee of Management.

"We should also very cordially welcome members of your Society if they should wish to become members of the Institute."

A circular accompanying Dr. Reid's letter explains that the British Institute of Radiology is being organized by a committee representing the Royal Society of Medicine, the Röntgen Society, and the British Association for the Advancement of Radiology and Physiotherapy.

A lease of suitable premises for the Institute has been consummated.

"The aims and objects of the Institute may be briefly summarized as the provision of a professional center for research and education in the application of *x*-rays, radium and kindred agencies in medical practice."

PROF. FORSSELL JOINS OUR FOREIGN COLLABORATORS

It is with great pleasure that the Journal announces the addition of Prof. Gösta Forssell of Stockholm, Sweden, to the list of our foreign collaborators.

Prof. Forssell's work and the excellent publication, Acta Radiologica, of which he is editor, are so well known to roentgenologists in this country that no comment is necessary.

RADIUM SOCIETY MEETING

The American Radium Society will hold its Ninth Annual meeting at the Drake Hotel, Chicago, Illinois, June 9 and 10, 1924. Those members who expect to attend the American Medical Association meetings at the same time, will find the Drake Hotel one of the most up-to-date and conveniently located hotels in Chicago, especially in relation to the exhibits and scientific sessions of the American Medical Association. Reservations can be made immediately through the Arrangement Committee of the American Radium Society by addressing Dr. Henry Schmitz, 25 East Washington St., Chicago.

The scientific sessions of the American Radium Society will be held at the Drake Hotel. Further information regarding the program and clinics will be announced when the arrangements have been fully completed.

BRITISH JOURNAL CHANGES ITS NAME

"Beginning with January, 1924, the name of the Archives of Radiology and Electrotherapy was changed to The British Journal of Radiology and is the official organ of the British Association of Radiology and Physiotherapy. The size has been changed practically to that of The American Journal of Roentgenology and Radium Therapy. The American Agency has been placed in the hands of Paul B. Hoeber, Inc., Publisher of The American Journal of Roentgenology and Radium Therapy, to whom subscriptions may be sent."

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

APPLICATION OF THE ULTRAVIOLET LIGHT WITH QUARTZ LAMPS TO THE PERINEUM IN SKIN AFFECTIONS

BY CARLOS HEUSER, M.D.

BUENOS AIRES, ARGENTINA

THE use of quartz lamps with the ultraviolet light, in addition to roentgen-ray applications, is the most efficacious treatment for eczema of the perineal region, vulva, anus, etc.

Finding that with our ordinary apparatus it is difficult to make the applications conveniently for an extended length of time in the region of the perineum, I conceived the idea of placing the lamps of quartz in a chair, where the patient can receive the light while in a seated position.

As will be seen by the illustrations, the seat of the chair in question has an opening through which the rays of quartz light pass, and beneath this opening at a distance of 40 cm., there is the lamp which is manipulated from outside. The lamp is enclosed in a box fitted into the space within the four legs of the chair.

In this manner the patients are able to sit with the affected part over the opening of the chair and receive the ultraviolet light treatment during five, ten or thirty-five minutes with comfort and ease.

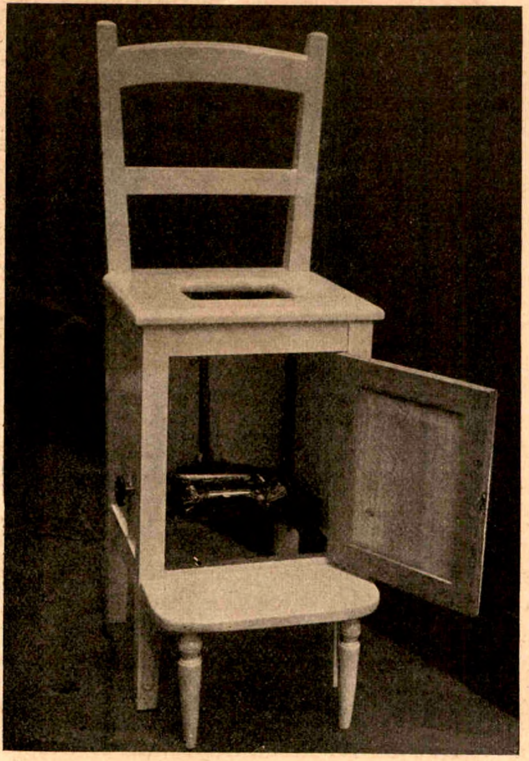

Fig. 1.

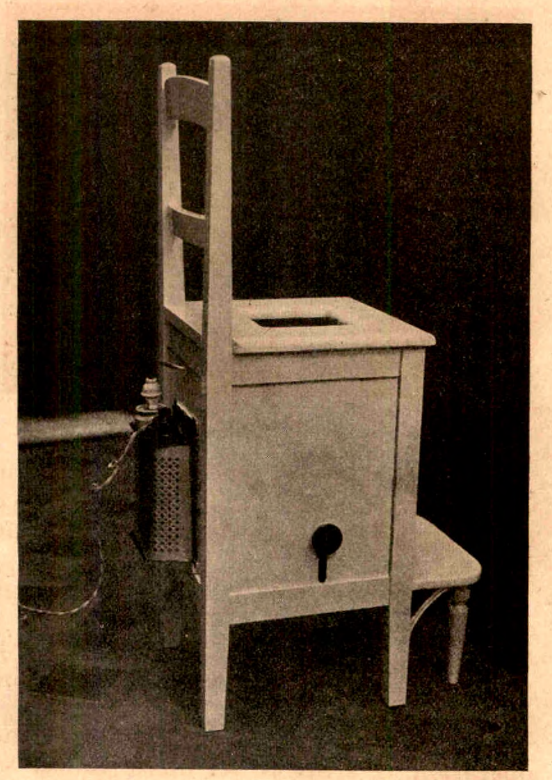

Fig. 2.

EXTRACTION OF FOREIGN BODIES IN DAYLIGHT WITH ROENTGEN RAYS

BY CARLOS HEUSER, M.D.

BUENOS AIRES, ARGENTINA

I HAVE modified the principle of Doctor Grasley's table in an effort to carry out a roentgenoscopic examination, during the act of operating to extract a foreign body, while with the free eye the surgeon can see to direct the operation that is being performed.

Hitherto this was not feasible, as it was either necessary to perform the operation in a dark room or else direct one of the assistants to guide the surgeon with roentgenoscopic control, a process which was awkward and difficult.

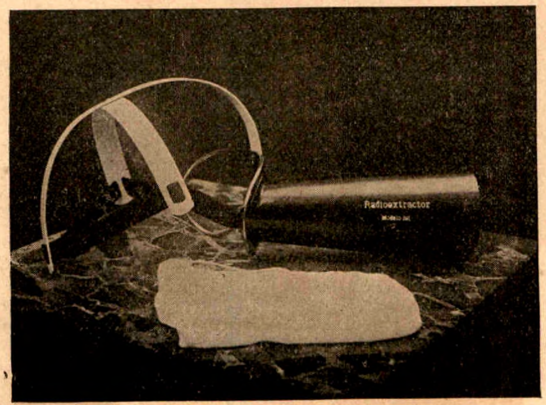

FIG. 1.

The apparatus consists of a metal frame which is conveniently adjusted to the face by means of an elastic band put over the head.

To this metal frame an aluminum tube is soldered, at the end of which there is a roentgenoscopic screen with its leaden eye piece, so that one eye is free, while the other is covered with the tube.

On this tube there is placed, during the operation, a strip of sterilized gauze, so that the surgeon may be able to handle the tube or touch the wound.

To use the tube, roentgenograms are taken in order to ascertain and to mark the spot which is most capable of being attacked in relation to all the neighboring organs.

When the surgical cleaning has been done and that part of the patient which contains the foreign body has been adjusted on the table above the roentgen-ray tube, the operation may proceed, the tube being illuminated as may be necessary.

Through the opening of the apparatus the surgeon can, with one eye, observe the relation of different organs to the foreign body as he operates, while with the other eye he can follow his own movements, until the foreign body is reached. Then under the double control of the rays and eyesight, it can be extracted.

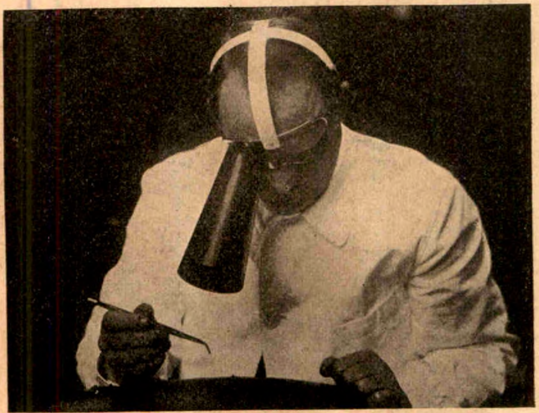

FIG. 2.

During the act of operating it is not necessary to illuminate constantly with the rays, but only from time to time, and for a few seconds, since the object is merely to establish the relationship and guide the surgeon as to the track he must follow till the foreign body is reached.

After the foreign body has been extracted an assistant removes the helmet from the surgeon who continues the operation in accordance with requirements.

The apparatus may be used not only to remove a foreign body; but also in various bone operations while operating, one can plainly see on the screen how he is proceeding.

A DEVICE FOR CENTERING THE PATIENT BEFORE THE UPRIGHT STEREOSCOPIC PLATE-CHANGER

BY EDWARD S. BLAINE, M.D.

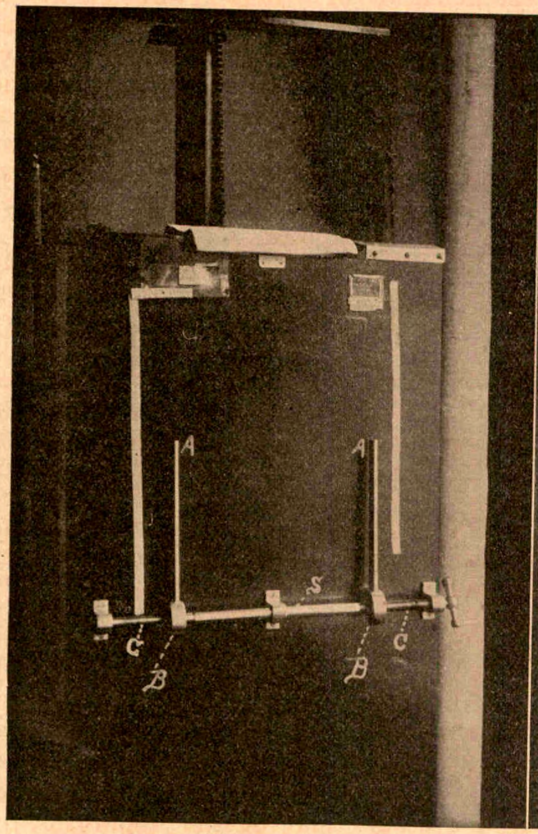

FIG. 1.

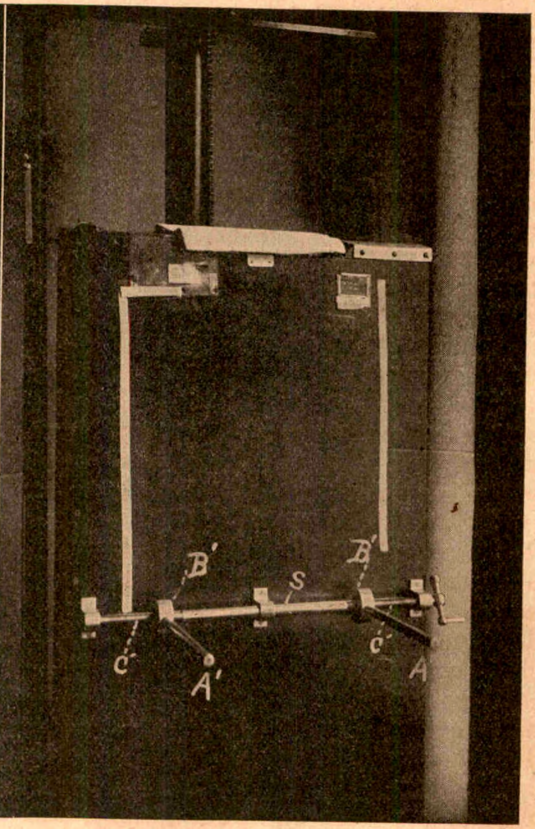

FIG. 2.

THE main feature of this, is a rod so threaded that the centering arms which it carries are moved symmetrically from or toward the center by turning the rod. The nuts which carry these centering rods are so notched as to permit the rods to stand out at right angles to the plane of the film, or to be turned vertically upward against the plate changer and thus out of the way. The illustrations and legends are self-explanatory.

A-A′ Centering rods.

B-B′ Stop notches in centering rod carrier nuts.

C-C: C′-C′ Right-hand and left-hand threading on screw-rod.

D The rectangular base (shown only in the diagram).

S The screw-rod.

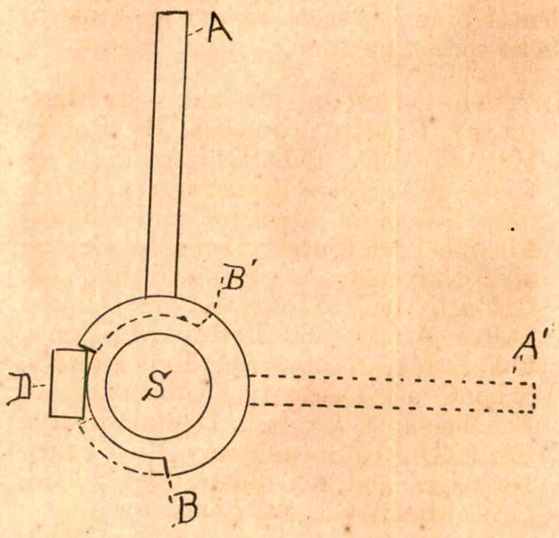

FIG. 3.

Dental and Oral Radiography. A Textbook for Students and Practitioners of Dentistry. By James David McCoy, M.S., D.D.S., F.A.C.D., Professor of Orthodontia and Radiography, College of Dentistry, Univ. of Southern California. Price $3.25. 194 pages and 116 illustrations. 3d Ed. C. V. Mosby Co., St. Louis, 1922.

The author states in the preface to the second edition that he feels within reasonable bounds when he states that "the x-ray has done more to improve dentistry than any other agent that has come into it during the past ten years."

In the prefaces to the various editions, emphasis is laid upon the fact that the book has been written primarily as a textbook for students of dentistry. It admirably fulfills the author's purpose in this respect. The book is written in a clear, simple style and develops the subject in a logical manner especially adapted to the needs of the student.

The entire subject is dealt with in such a complete manner, however, that a reading of the book will repay even the experienced roentgenologist.

The chapters on technique, giving careful detailed descriptions, illustrated by numerous drawings and photographs, and the chapters on interpretation and indications for the use of roentgenography in dental practice, seem to the reviewer to merit special mention.

Interpretation of Dental and Maxillary Roentgenograms. By Robert H. Ivy, M.D., D.D.S., F.A.C.S., Professor of Maxillo-Facial Surgery, Graduate School of Medicine and Clinical Maxillo-Facial Surgery, School of Dentistry, University of Pennsylvania, Lt. Colonel, Medical Reserve Corps, United States Army: and LeRoy M. Ennis, D.D.S., Instructor in Radiography, School of Dentistry, University of Pennsylvania; Captain, Dental Reserve Corps, United States Army. Price $4.00. 195 pages and 403 illustrations. 2d Ed. C. V. Mosby Co., St. Louis, 1923.

As the title indicates, this book deals almost entirely with the interpretation of dental and maxillary roentgenograms. In the interests of uniformity and clearness the attention of writers is directed to the following sentence in the introduction: "The American Roentgen Ray Society, which may be properly taken as the official representative of this branch of medical science in the United States, has adopted in honor of Roentgen, the discoverer, a nomenclature which I consider it advisable to follow."

The book covers the subjects of the normal anatomy of the teeth and jaws and their roentgen appearances, pathology from the clinical and roentgenographic examination. There are chapters on stereoscopic roentgenography and on roentgenographic findings in relation to prognosis and treatment. Probably the most valuable part of the book is the large section given to detailed description and interpretation of numerous roentgenograms.

Diathermy and Its Application to Pneumonia. By Harry Eaton Stewart, M.D. Price $3.00. 226 pages, 45 illustrations and 15 charts. Paul B. Hoeber, Inc., New York, 1923.

This is a concise account of the physics of diathermy and of the apparatus for production of the bipolar high frequency current of D'Arsonval.

A chapter is devoted to a short description of the uses of diathermy in surgery.

Numerous case histories are given to demonstrate the effect of diathermy upon patients with pneumonia. The technique of the treatment is described and its beneficial results shown by mortality and other statistics.

Medical Axioms, Aphorisms and Clinical Memoranda. By James Alexander Lindsay, M.A., M.D., F.R.C.P., Professor of Medicine in the Queen's University of Belfast, Consulting Physician to the Royal Victoria Hospital, Belfast and to the Ulster Eye, Ear and Throat Hospital. Price $2.25. 192 pages. Paul B. Hoeber, Inc., New York, 1923.

This collection of short, pithy axioms and aphorisms from the time of Hippocrates and Aristotle to that of William Osler and G. Bernard Shaw is interesting and stimulating.

The clinical memoranda based on the author's own experience as an observer and teacher are of real practical value. A few of them, however, might be considered somewhat belated. Surgeons would hardly agree, for instance, to place surgery in a subordinate position to medicine in the treatment of exophthalmic goiter.

RADIODONTIA (Dental Radiography and Diagnosis) QUESTIONS AND ANSWERS. By Howard Riley Raper, D.D.S., formerly Professor of Radiodontia, Materia Medica, and Operative Technic, and Junior Dean, Indiana Dental College. Price $4.50. 179 pages, with 52 illustrations. Dental Items of Interest Publishing Co., New York, 1923.

The method and aim of this book is indicated by the following quotations from the preface. "Broadly speaking, the study habit is simply the habit of asking one's self questions; then looking up the answer."

"The questions-and-answers form is a convenient one; the reader may glance at the question; then, if he is sufficiently interested, read the answer."

"By adopting this method of presenting the subject I have been able to include a great deal in a comparatively small space. . . ."

The book is intended for students of radiodontia, both graduates and undergraduates, and as a guide for teaching the subject. The form of questions and answers lends itself especially well to the latter purpose. The volume covers the subject of dental roentgenology very thoroughly, including description of apparatus, details of technique, interpretation and differential diagnosis. A good index renders the book useful for reference.

THE AMERICAN ANNUAL OF PHOTOGRAPHY, Vol. xxxviii. Edited by Percy Y. Howe. Cloth. Price $2.50. 296 pages. The American Annual of Photography, Inc., Yonkers, N. Y, 1923.

After reading this admirable annual one again turns to the editor's preface in complete accord with the statement that: "Photography has at last reached a position where we can truthfully say it has a place in all our lives whether we are actively engaged in it or not."

The volume contains many contributed articles, some of which should be especially interesting to the roentgenologist, and the appendix is replete with tables and formulae which in themselves render the work highly desirable to anyone concerned in "dark-room" problems.

Profusely and beautifully illustrated.

NOSOGRAPHY IN MODERN INTERNAL MEDICINE. By Knud Faber, M.D., Professor of Internal Medicine, University of Copenhagen. With an Introductory Note by Rufus Cole, M.D., Director of Hospital, Rockefeller Institute. Cloth. Price $3.75. 235 pages, with 21 full page illustrations. Paul B. Hoeber, Inc., New York, 1923.

This book is a review of the history of clinical medicine from the time of Sydenham, with special reference to the influence of nosology upon its progress.

Nosology or nosography is defined as "the description of diseases." The author considers it the very keystone of medical progress. Although he does not minimize the importance of a knowledge of symtomatology, pathology, bacteriology, etc., he attempts to show that all of these are of importance in medical progress only as the information gained from them enables the clinician to describe each disease more accurately.

In the introductory note, Dr. Cole writes as follows:

"Through an historical study the book attempts to formulate the idea of what clinical medicine really is, and it therefore forms a definite starting point for thought and discussion. That it will give rise to these is certain.

"Moreover, besides presenting in a clear and consecutive manner the history of internal medicine, the book indicates very clearly the lines along which clinical medicine is developing today. It is, therefore, of great value even to those who are not interested in the more philosophical problems which are discussed."

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

Sergent, Emile, and Cottenot, Paul. Radiological explorations of the respiratory apparatus after intratracheal injection of lipiodol. (L'exploration radiologique de l'appareil respiratoirè apres injection intratrachéale de lipiodol.) *J. de radiol. et d'electrol.*, Oct., 1923, vii, 441.

The method proposed by Sicard and Forestier, make it now possible to render the tracheobronchial tree opaque by the injection of lipiodol.

Lipiodol is poppy oil 40 per cent, containing 0.54 gm. of iodine to the cubic centimeter. This is very opaque to roentgen ray on account of its high iodine content, and it is perfectly tolerated.

Technique. Lipiodol may be introduced into the trachea through the glottis or below it. The transglottis route can be used only by expert use of the laryngeal mirror after cocaine anesthesia of the larynx. For that reason, the authors preferred the route below the glottis, using a 40 c.c. strong metallic syringe and a curved needle, piercing the trachea through the cricothyroid membrane. Tracheal anesthesia was necessary in order to avoid the cough. They injected 20 c.c. at first and in some cases have increased it to 40 c.c. without inconvenience. The position of the patient varies with the part of the lung to be injected; when seated the lipiodol fell directly into the lower bronchi, principally the right inferior; in lateral decubitus, the lower side filled first; in dorsal decubitus, the right side filled first.

In order to reach the summit it was necessary to lay the patient on the back or side with hips elevated and shoulders down on the incline. The position varies with the aim sought. The roentgenography should be done at once when the lipiodol is in place, reducing the movements of the patient to an indispensable minimum before taking the negative. Movements are liable to produce cough and thus expel the lipiodol.

The authors had not observed any serious accidents due to filling the trachea and bronchi with lipiodol, and none has been noted by others using this method.

Elimination of lipiodol. The greater part of the lipiodol is eliminated within two hours after the examination. The movements of getting up and dressing cause a cough and the lipiodol is expectorated or ingested. It can be shown in the stomach by screen examinations. In three or four days none is left in the lung, though in some subjects it may remain for a much longer time. Sicard and Forestier found it three or four months after the examination. From one-half to two-thirds of the lipiodol is ejected by the cough and the remainder is absorbed by the mucous membrane, as is proven by the iodine in the urine.

Two of the authors' patients presented slight signs of iodism for forty-eight hours, consisting of a swelling of the face, watering of the eyes, and in one, painful swelling of the salivary glands. The saliva of both contained iodine.

Lipiodol injected for therapeutic purposes can be found at the point of injection two years later.

Data is furnished of normal roentgenological anatomy of the respiratory apparatus by injections of lipiodol.

Conclusions. Lipiodol permits the study on the living man of the form and trajectory of the bronchial trunks.

The authors found the large left trunk bronchus and the bronchus of the left lower to be completely hidden behind that of the heart, and descending parallel with the left ventricular border and within its shadow. Therefore, it is impossible to see them from the front, but their whole length can be seen from a right anterior oblique position. The lipiodol marks out the bronchial tree to the small branches.

In the plates obtained by lipiodol, one clearly differentiates the bronchial shadows from those of the hilum.

The lesions which lipiodol makes evident are:

(1) Deviations of trachea and bronchi.
(2) Modifications of permeability of a bronchial area.
(3) Dilatation of the bronchi.
(4) Pulmonary cavities.
(5) Bronchial and pleural fistulæ.

Sessa, P. A case of sarcoma of the ulna. *Radiol. med.*, 1923, x, 242.

A patient forty-three years of age, suffered from pain in the region of the right olecranon. Aside from the pain, there was a heavy feeling, but neither swelling nor redness. The arm was kept quiet, but soon severe pain on slight traumatism developed very rapidly in the forearm. A surgeon pronounced it a fracture of the olecranon. After forty days of immobilization the patient felt much better, and this condition continued for six months. When he became worse roentgen examination was made, and the upper third of the elbow was found deformed. The olecranon was changed into a vacuolized bony mass. Its outer border was sinuous and irregular. Light zones of bone rarefication were interspersed between bone trabeculæ. This mass was divided from the ulnar diaphysis by a tortuous, irregular, lighter line. In some parts the structure was entirely decalcified. No signs of periosteal change were seen.

The Wassermann reaction was negative. A surgical intervention for diagnostic purposes was made. In the epiphyseal structure a cavity of the size of a nut was found, which was partly fibrous and partly osseous. Granulomatous-looking tissue was found inside of it, which bled easily. The examination of the specimen showed a myelogenous sarcoma, with polymorphous cells. The upper third of the ulna was resected. Three weeks later radiation with the erythema dose, from the external and internal borders was made at a focal distance of 40 cm. with 200,000 volt tension, and with 2 ma. The filtration employed was ½ mm. Zn. and 1 mm. Al. The elbow was immobilized at a right angle, and in six months the roentgenogram and general state were very satisfactory.

Veau, Victor. Surgery and radiotherapy of the thymus. (Chirurgie et radiotherapie du thymus.) *J. de. radiol. et d'electrol.*, Par., Oct., 1923, vii, 450.

This report is only on the hypertrophies of early infancy, and does not consider cases of benign or malignant tumors of the thymus developed in the adolescent or adult, nor chloroform deaths found on autopsy to have a large thymus.

Surgery has failed in these cases and irradiation should replace it. Reference is made to cases in which thymectomy had been done on patients who were really suffering from tracheobronchial adenopathy with disseminated tuberculosis.

Stone, W. S., and Ewing, James. An unusual alteration in the natural history of a giant-cell tumor of bone. *Arch. Surg.*, Sept., 1923, vii, 280.

SUMMARY

The record of the case presented is of interest from several aspects. The transformation of the structure of a benign giant cell tumor, while evidently very rare and not previously recorded in this disease, finds a parallel in similar transformations that have occurred in many other tumors, benign and malignant, after surgical and other forms of trauma.

The development of metastases in this case proves no exception to the rule that the benign giant-cell tumor never produces metastases. Here, the metastasizing tumor was not a giant-cell tumor, but a malignant growth that developed out of a giant-cell growth, as the result of various insults, in which curettage and imperfect irradiation probably played the chief part.

Our search of the literature seems to show that there is no satisfactory record of metastasis of a giant-cell tumor in its original form. That such metastases have not been recorded among the great number of these tumors that have been subjected to repeated curettages seems to us a matter of surprise.

The occurrence of metastases in this case seems to stand as a somewhat hazardous feature of the usual surgical treatment of the benign giant-cell tumor and as evidence in favor of the treatment by external radiation.

The unfortunate outcome in this case suggests that the surgical plan of treatment, if adopted in these cases, should be adhered to, and that it is unwise to attempt to combine surgical methods with postoperative radiation by means of radium inserted in the tumor cavity.

Steinfield, Edward, Pfahler, George E., and Klauder, Joseph V. Clinical and roentgenologic study of one hundred and five cases of syphilis with reference to the cardiovascular system. *Arch. Int. Med.*, Oct. 15, 1923, xxxii, 556.

SUMMARY

A brief review of the literature on cardiovascular syphilis is made. The pathology of syphilitic aortitis is discussed.

The symptomatology of syphilitic aortitis is presented with particular reference to early symptoms. The importance of an early diagnosis is emphasized.

Of a group of 105 male syphilitic patients studied by clinical methods, 60 were white and 45 negroes. They varied in age from twenty-two to fifty-nine years, and the duration of syphilitic infection varied from one to twenty or more years. Approximately, one-fourth were between forty and fifty years of age. Twelve patients, approximately 10 per cent, were found to be suffering from aortic or myocardial disease. Of these, 3 were white and 9 negroes. Of the aortic lesions, one was diagnosed as aortitis, two as aortic dilatation, six as aortic dilatation and insufficiency and two as aneurysm.

Of 63 patients studied by roentgenologic methods, aortic disease (including aneurysm) was noted as being definitely present in 19 or 33 per cent. Roentgenologic examination included fluoroscopy, teleroentgenograms made at a distance of 2 meters, and oblique films. The higher percentage of patients with aortic disease discovered by roentgenologic examination is in accord with pathologic studies reported by others and reviewed in this report.

The so-called Wassermann-fast syphilitic patient is discussed with particular reference to cardiac syphilis.

Of a total number of 25 patients with neurosyphilis, there was an associated aortic disease in 4. The relative infrequency of an active syphilitic process involving one or more systems in the same patient is discussed.

Liss, L. Edward. A roentgenological study of tuberculosis of the lungs and intrathoracic glands in infancy and childhood. *Am. J. M. Sc.*, Sept., 1923, clxvi, 396–402.

Tuberculosis in infancy is of two types, acute and chronic. The first is the more common of the two and may be subdivided into:

(1) Tuberculosis of the glands.

(2) Tuberculosis of the lungs.

In both cases, by means of the roentgen-ray follow-up, the process can be shown to have a definite and fairly orderly sequence: a period of congestion, a period of retraction or spreading, complete or incomplete, and a period of softening. While it is true that in the early or congestive stage, the process may not be distinguishable from any of the acute infections, in the second stage, that of retraction or expansion, the conditions assume characteristic appearances; and in the third stage there should be no difficulty in the diagnosis. For exact visualization of these changes repeated roentgenographic investigation is absolutely essential.

Heuser, Carlos. X-ray toxemias. (Toxemias roentgeniana.) *La Semana Medica*, Aug. 16, 1923, xxx, 309.

Roentgen rays produce in the body the following effects: (1) Local disturbances–roentgen dermatitis; (2) general disturbances—vomiting, diarrhea, debility, drowsiness, discomfort, and fatigue; (3) late manifestations—trophoneurotic ulcers, coming on a year after the application, toxemias, nausea, and vertigo which come from six months to a year after the cessation of treatment.

The first two effects have been studied, but the third has been reported in only isolated instances, without being classified or described.

The rays used to cure a superficial lesion do not attack the organism if they do not exceed a certain biological dose, but the rays applied with a cellular destructive dose produce in the organism a local radiodermatitis according to the dose, up to ulceration. They should be applied only in exactly measured dose, previously determined.

The general disturbance due to the elimination of the cellular detritus may be diarrhea or vomiting from gastrointestinal irritation; dryness, irritation, and painful breathing due to the effect on the respiratory tract; or nausea and vertigo from cerebral irritation.

All of these lower the vitality of the patient, and it must be remembered that the effect accumulates when enough time has not been allowed for the organism to recover.

These general disturbances (vomiting and diarrhea) are not only symptomatic of epithelial or mucous lesion, but of a disturbance of the endocrine system—ovaries, thyroid, thymus, or suprarenal capsule.

A case is reported of recurrent cancer of the breast in which there was given a roentgen dose of intense erythema over the chest and shoulder. Six months afterward a roentgenogram of the lung showed various small round shadows due to pulmonary sclerosis. The patient died of cancer of the mediastinum. The autopsy showed sclerosis of the pulmonary parenchyma which corresponded to the area treated. These sclerotic areas were formed by connective tissue which enclosed not only the vessels, but principally the bronchioles. They contained no cancer cells.

In various cases, late trophoneurosis was observed, although the cases had not received a lethal cancer dose.

This gangrenous degeneration is observed principally in locations where there is bone. Secondary rays from the bone unite with the direct rays to produce the total effect.

Conclusion. Roentgen therapy may produce disturbances which manifest themselves a year or more after the treatment. These manifestations are in the nature of a trophoneurosis resulting in mummification of the skin and dry gangrene of the entire locality. The process is cured by complete extirpation.

Bonneau, Raymond. Diverticules du duodenum. *La Presse Medicale*, Sept. 26, 1923, lxxvii, 817–819.

The duodenal diverticulum is filled by causing the patient to lie on the right side and then to compress, with the right hand, the duodenojejunal angle against the spine.

Roentgenologically the diverticulum may be confounded with an ulcer of the duodenum or with a dilatation of the ampulla of Vater.

The connections with neighboring organs are most useful to know. There may be intimate relations with the bile ducts and with the pancreatic duct which find trouble in evacuation, and dilate. Sometimes they empty into the diverticulum itself. In the pancreatic canals this goes on to fatty necrosis and hemorrhagic pancreatitis. Gall-stones may lodge in the diverticulum. Sometimes, the diverticulum penetrates into the mass of the pancreas from which it appears almost impossible to extract it surgically. Evacuation of the stomach is, under certain circumstances, difficult and retarded. The pancreatico-duodenal vessels, and those of the transverse mesocolic vessels eventually spread out on the surface of the diverticulum and form a groove. Thus one sees why a diverticulitis or peridiverticulitis may become serious. References are given to the literature on diverticula.

Blacker, Sir G. The treatment of menorrhagia by radium. *Arch. Radiol. & Electroth.*, July, 1923, xxviii, 47-55.

Radium can be used for the treatment of menorrhagia in the following conditions:

1. Cases associated with the menopause.
2. Cases due to presence of small fibromyomata in the uterus.
3. Cases in young women who present no signs of genital or pelvic disease.

All these can be safely and efficiently treated by the intrauterine application of radium.

The use of radium in fibromyomata should be strictly limited to small tumors, not larger than the uterus at the fifth month of pregnancy, not undergoing any form of degeneration, not complicated by any accompanying disease of the appendages and not projecting markedly into the interior of the uterus. Within these limitations radium gives good results. It is wise not to use it in submucous tumors since it is liable to cause sloughing and infection of the growth.

Radium should never be introduced into the uterus when there are signs of inflammation in any part of the genital tract.

It has been calculated that the uterus will stand a dose three times greater than that required to produce a skin reaction.

The author reports 68 cases, as follows: 34 for profuse hemorrhage at the menopause; 23 for hemorrhage with fibromyomata of the uterus, and 11 for menorrhagia without general or pelvic disease.

In the 34 cases of hemorrhage at the menopause complete amenorrhea has resulted—15 immediately after treatment, 11 after one period, and 7 after two or more periods.

In 23 cases complicated by fibromyomata complete amenorrhea followed the treatment in 16—10 without any further bleeding, 3 after one period, and 3 after two or more periods.

In the 11 cases treated for hemorrhages not due to general or pelvic disease, complete amenorrhea has resulted in 6, 2 have undergone hysterectomy, and in 3, hemorrhage has been controlled by the treatment.

The amenorrhea following the application of radium is no doubt due to its effect upon the ovaries and to the destruction of the Graafian follicles.

Ochsner, A. J. The treatment of cancer of the jaw with the actual cautery. *J. Am. M. Ass.* Nov. 3, 1923, lxxxi, 1487-1490.

After describing the instruments, etc., and giving the reasons why removing a portion of a cancer for microscopic examination is not safe he says that there is, however, a safe method of obtaining a portion for microscopic examination, namely by use of the cautery knife.

During the discussion, Dr. Henry Schmitz of Chicago said: "Radium and roentgen-ray treatment in cancer of the jaws should never constitute the sole treatment, but be regarded an aid to surgery. Radium has a local intensive effect and therefore should be evenly distributed throughout the tumor mass and its periphery by the use of steel needles or emanation seeds. Roentgen rays are rather extremely diffused and therefore may be applied to large areas; for instance, the glands of the neck and sub-maxillary regions. The modern 200 kilovolt roentgen ray, heavily filtered, should not be used in jaw cancers, but preferably the 120 and 140 kilovolt roentgen ray, filtered with 0.25 or 0.5 mm. of copper. The latter method insures greater absorption of the rays which, of course, is essential for success. We should also avoid the destruction by rays of important secretory glands such as the parotid and the sub-maxillary. We should save at least one of each pair. If we do not do so, the patient will evince a wasting away leading to death, though the carcinoma may have been destroyed."

Dr. Gordon B. New, of Rochester, Minn. said: "In the sarcoma group, radium alone is about all that is necessary, while in the epithelioma group, thorough cauterization is the important thing. I believe that radium has done much to increase the mortality in cancer about the nose, throat and mouth, owing to the fact that it is being used in conditions in which it is not indicated, and used by persons without special training. Thickened leucoplacias and so-called precancerous conditions about the mouth are being treated with radium, which sometimes heals over the surface, and then the growth recurs as an active squamous-cell epithelioma. Radium is a very important adjunct in the treatment of malignancies, but the selection of cases for its use alone and with surgery is very important."

Dr. Ochsner said in closing: "It is true that the incomplete operation increases the growth.

"I believe that Dr. Schmitz' insistence on the fact that the roentgen ray or radium must be used as an aid and not as a primary treatment should be borne in mind and emphasized thoroughly because as an aid it certainly has tremendous value.

"Dr. John Nuzum has been working for seven years with a filtrable micrococcus, which he finds in human cancer, which he can inoculate and which will produce cancer in mice and dogs in a certain number of cases. He is still at work, and will probably have to take a number of years before he can get all of the elements worked out."

Jehn. The significance of the roentgen ray in the development and diagnosis of thoracic surgery. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, 6.

Thoracic surgery has been retarded in its development as much by the interpretation of clinical signs as from technical difficulties. Only since the roentgen rays have been employed in its diagnosis, and since pneumothorax can be avoided, has it developed more satisfactorily. One of the great advantages is that one can follow the case in its course by means of roentgenograms. Stereoscopic methods are especially adapted to thoracic work since this is a region where the cubic dimensions are of importance. Roentgen stereograms have greatly improved thoracic diagnosis, and have given suggestions for operative treatment, as well as for after-treatment. Great benefit has been experienced from the differential pressure method, and the roentgen ray has greatly perfected this method. Pathological anatomy can be studied with greater safety.

In surgical disease of the thoracic walls the importance of the rays has not been so great as in many other parts of the body, though it has been of assistance in the treatment and diagnosis of fractures of the bony thorax. They will show whether pleura and lungs are involved, whether the mediastinum has been injured, whether there are tumors in the walls, whether the tumors of the breast extend inward, etc. In osteomyelitis and tuberculosis of the bony thorax the fistulae are well recognized and the differentiation between tumor and gumma facilitated. Abscesses of the ribs or pleura may be located, and empyema delimited. The inter-relation between the walls and the organs of the thorax is clearly brought out.

In surgery of the pleurae and lungs not all complicated pathological conditions can be recognized with absolute safety, even by means of the roentgen ray. However, the combination of roentgenoscopy, roentgenography, and stereoscopy will show the function of the lung under normal and pathological conditions. Diseases of the serous membranes, of the parenchyma and bronchial system may be recognized with precision The difficulty arises where large exudates and scar tissue dim the picture; and here are the limitations of the method. In pneumothorax the roentgen ray will help to follow the degree of filling, the resorption, and all the conditions of pressure within the thorax. Movements of the lung with closed pneumothorax will resemble the normal function as long as negative pressure exists. Paradoxical respiration, mediastinal flutter, etc,, can be clearly observed on the roentgen screen. Pressure pneumothorax may be shown very nicely in the serial pictures. It is generally caused by traumatism, or by purulent degeneration of an exudate, and gas formation. One will suddenly see a change in the mediastinum, a lowering of the diaphragm, and inspiratory dilatation of the thorax. If one punctures this pressure pneumothorax while looking at the screen, one can see how the pressure conditions in the pleural space are equalized. The mediastinal displacement disappears and danger of death is removed.

Total and partial exudates, epidiaphragmatic, mediastinal and apical empyema, especially the interlobular, have been recognized fully only since roentgen rays have been employed. It must be mentioned that even with this aid it is not always possible to differentiate between pulmonary abscess, tumors, and interlobular empyema. In these cases the pictures must be taken at various angles, and doing this, the interlobular spaces must be taken into account. Mediastinal empyema will often cause some difficulty on account of the broadening of the cardiac shadow. The exudate may propagate pulsation. Basal empyema may be differentiated from subphrenic abscess by the concave border towards the pulmonary apex. The subphrenic abscess has a convex border, providing there is not a simultaneous irritative exudate of the pleura. In the subphrenic abscess the movements of the diaphragm are impaired. In comparing the pictures, increase of exudate and the onset of resorption may be watched.

If an air bubble is seen above the exudate, one may conclude that attempts at puncture of the pleura have caused it, but it may occur in purulent exudates in the form of gas empyema, and may mean that an exudate has ruptured into the lung. Clinically, in the latter case, the patient who has a high temperature and so far had no expectoration, will suddenly cough up great quantities of sputum.

If the lung does not expand after an operation there may be residual cavities, and the conversion of pulmonary tissue into connective tissue will be seen in the roentgenogram. The author does not employ contrast fillings because bismuth intoxication, emboli, and aspiration of the contrast media through bronchial fistula have been observed. Roentgenograms show the necessity of treating these residual cavities by means of Schedé plastic operations. The indications for the place and the extent of the removal of bone from the wall are given by the roentgenogram. It will show the operative results.

Direct and indirect bronchial fistula will be well shown. Chronic empyemata in most cases will clinically present the picture of tuberculosis, bronchiectasis, or pulmonary abscess, especially if they communicate with the bronchus. The roentgen ray will show, encapsuled in thick masses of connective tissue, extra-pulmonary pus foci with an air bubble. If this is absent, drying up of the exudate or calcareous degeneration may exist. These pictures very often resemble tumors. Hemo- and pneumo- and hemopneumothorax will show similar pictures to intrathoracic organic injuries, with the difference that the recent injuries will show no connective tissue complications. Mixed infections of tuberculous pleural exudates, which have been evacuated, and which have formed residual cavities, will yield the same roentgenogram as those existing after non-tuberculous empyema.

KUESTNER, HANS. Recurring questions on dosimetry. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, 86.

Dosage involves the determination of a ray-mixture of definite hardness and intensity, applied for a definite time to a definite area of the body.

A standard dosimeter must be found, the sensitiveness of which is well known. It must be placed at a point which is affected by nothing in its surroundings. All apparatus must be standardized by it as to length of waves and other qualities. It has been found that the biological dose is an uncertain measure, and cannot serve as an entity, while the physical dose can be determined very exactly. Measuring of roentgen-ray energy has not been effected experimentally in a satisfactory manner. It is therefore advisable to use the sensibility of the standardizing apparatus as an entity. In this manner, the different dosages will be reduced to a standard measurement, and a comparison among them will become possible.

MAYO, CHARLES H., AND PEMBERTON, JOHN, J. Surgery of the thyroid and its mortality. *Ann. Surg.*, Aug., 1923, lxxviii, 145–149.

According to the dangers attending surgery, all lesions of the thyroid may be divided into two groups: goiters not associated with hyperthyroidism and goiters associated with hyperthyroidism. In those not associated with hyperthyroidism the dangers are those due to accidental causes to which any operation of equal magnitude are subject. In those associated with hyperthyroidism the greatest danger lies in the disease itself or the residual effects of the disease; thus operation may precipitate an acute exacerbation of hyperthyroidism from which the patient does not recover.

In the Mayo Clinic the incidence of postoperative obstructive dyspnea and pneumonia have been materially decreased since it has been appreciated that both are at least partially avoidable. The incidence of postoperative pulmonary infections has been reduced by avoidance of prolonged anesthesia and injury to the recurrent laryngeal nerve. In the last sixteen months, 819 thyroidectomies were performed on 819 patients, 3 of whom died, a mortality of 0.36 per cent.

The goiters associated with hyperthyroidism include exophthalmic goiter and adenoma with hyperthyroidism. The development of acute hyperthyroidism and the presence of visceral degenerative changes comprise the added dangers to surgery in both types, but as the relative dangers vary in the two types it is desirable to discuss them separately.

Exophthalmic Goiter. In recent years a larger proportion of cases is coming to surgery early in the course of the disease. This is illustrated by comparison of the data for different periods relative to the duration of the hyperthyroidism. In 1909 the average duration of hyperthyroidism was thirty-one months, in 1916 twenty-three months and for the first six months of 1922, nineteen months. This has reduced the mortality and improved the end-results.

The methods of combating postoperative hyperthyroidism, when it is once induced, are ineffectual. The mode of attack lies rather in prevention.

Preoperative preparation consists of medical and surgical measures. About 30 per cent on admission to the Clinic have a mild degree of hyperthyroidism, and, as the general health is unimpaired, routine preparation only is required.

Preliminary treatment of the hyperthyroidism is required in the other 70 per cent. By repeated basal metabolic estimations at intervals of every three or four days, the progress of the disease may be accurately watched.

A comparison of the operative procedures employed in the first four months of 1923 with those of the same period for five preceding years is interesting. Primary thyroidectomy was performed in 56 per cent of patients in 1923, while the average for the preceding years was only 38 per cent. Twenty-four per cent had two or more ligations before thyroidectomy in 1923 and the average for the preceding five years was 37 per cent. Under the combined medical and surgical management, primary thyroidectomy has increased 18 per cent and the necessity for two or more ligations has been reduced 12 per cent.

Adenomatous Goiter with Hyperthyroidism. The added dangers here are due to the possibility of the development of acute hyperthyroidism and to the presence of visceral degenerative changes. Owing to the usual mild intensity of hyperthyroidism, the possibility of severe acute hyperthyroidism is of relatively small importance, while the presence of visceral degenerative changes is the most influential factor in the mortality rate.

During the past sixteen months, there were 277 patients with adenomata and hyperthyroidism operated on. Nine patients died, a mortality of 3. 24 per cent.

STEWART, M. J., AND LODGE, S. D. On unilateral fused kidney and allied renal malformations.
Brit. J. Surg., July, 1923, xi, 27.

1. The horseshoe kidney:
   (*a*) Fusion at upper poles.
   (*b*) Fusion at lower poles.
2. The concrescent kidney:
   (*a*) The prevertebral fused kidney.
   (*b*) The unilateral fused kidney.
   (*c*) The pelvic fused kidney.

In 6,500 autopsies there was found one example of unilateral fused kidney. Morris found "one fused kidney other than horseshoe-shape" in 15,908 autopsies.

The author found horseshoe kidney in 0.21 per cent of these cases; congenital absence of kidney in 0.24 per cent and pelvic kidney in 0.04 per cent.

In one case of pelvic kidney, the left kidney was absent and the right was situated in the pelvis. It was connected with the bladder by a short, kinked ureter only 3 in. in length, and obtained its blood supply by a single large vessel given off at the bifurcation of the aorta. Pelvic kidney may be in either the median or lateral position.

In the case of unilateral kidney, the ureters invariably opened in the normal location in the bladder. The most careful cystoscopy would therefore not reveal the facts, hence the value of pyelography. The adrenals may be in normal location in these cases.

There is a bibliography of nineteen references.

WHITAKER, LESTER R. Malignant lymphoma (Hodgkin's Disease) *Arch. Int. Med.*, Oct. 15, 1923, xxxii, 538.

This article is based on a study of 40 cases of Hodgkin's disease with seven necropsies.

Lymphosarcoma is the most frequent mediastinal growth, producing irregular growths with sharply defined outlines somewhat nodular in shape, extending far beyond the limits of the mediastinum.

In Hodgkin's disease the lungs may be infiltrated giving the impression of tuberculosis. These shadows are usually oval or elongated.

The shadows of the two diseases, lymphosarcoma and Hodgkin's disease, cannot be absolutely differentiated.

To best interpret the roentgenographic appearances of Hodgkin's disease it is necessary to have a clear picture of the gross pathology in mind as the plate is being examined.

The glands vary considerably in density because fibrosis in them is progressive; therefore, the shadows are less dense in early cases than in the older ones.

Two of the 7 cases that came to necropsy had lymphomatous infiltration of the lungs.

Seven out of the 40 cases had pleural effusions, 5 in the left, and 1 in both pleural cavities.

The intrathoracic involvement in Hodgkin's disease is divided by Wessler and Greene, into four groups: (1) Mediastinal tumor, extending to the lung; (2) infiltrative type—the borders of the infiltrating mass are indistinct and irregular. (3) Isolated nodules of metastases in the lung; (4) Discrete nodes at the roots of the lungs.

Twenty-two of the author's cases were of class 1; 11, of class 2; none in class 3; while 33 were of class 4.

Lymphosarcoma cannot be said to be essentially different from Hodgkin's disease. The roentgenographic shadows of carcinoma are more definite, with sharper outlines than those of lymphoma.

Tuberculosis and Hodgkin's disease are similar, both from a clinical and a pathologic point of view, resulting in many erroneous diagnoses and much disadvantage to the patients.

A rapid and marked reduction in size of lymphoma is demonstrable by roentgenograms after one or two treatments, and is regarded by some as almost diagnostic.

There is a biblography of fifteen articles.

MULLER, F. W. The roentgenological study of infectious arthritis. *U. States Nav. M. Bull.*, Oct., 1923, xix, 393.

The subject is divided as follows:

1. The use of a constant technique in making roentgenograms of joints will often eliminate errors in diagnosis.

2. There is need for a standard classification of the various forms of chronic arthritis.

3. Some authorities believe infection is the etiological factor in all forms of chronic arthritis. Up to this time this fact has not been satisfactorily proven.

4. There are certain roentgenological findings which enable the roentgenologist to differentiate to a fairly accurate degree the various forms of infectious arthritis.

In acute infectious arthritis there is no evidence in the roentgenogram beyond the swelling of the soft parts.

In chronic conditions there is evidence of joint destruction, increase of synovial fluid, and cartilage change.

In pyogenic arthritis, at an early stage, there is swelling of the soft tissues and effusion into the joint; rarefaction may occur as a result of fixation or neighboring inflammation. The joint space is narrowed, depending upon the amount of destruction of cartilage.

In gonorrheal arthritis, except in the knee-joint, there are no characteristic roentgen appearances. In the knee there are two characteristic findings. First, thinning of the cartilage between the patella and femoral condyles, displacing the patella backward into the intercondylar space. To demonstrate this a lateral view is required. Second, small localized areas of rarefaction may be present, due to necrosis of the subcartilaginous bone at the lateral margins of the joint surfaces of the femur and tibia. This condition is best shown in anteroposterior views. Bony spines along the attachments of tendons are usually due to gonorrheal infections.

Tuberculous arthritis is characterized by soft tissue swelling, effusion in the capsule, and general blurring of the joint outlines, giving the appearance of a picture of poor quality. The bones outside the affected joint show normal detail and density, and in young people the epiphyses are enlarged and squared, from synovial irritation.

In the spine the process attacks the intervertebral disks and adjacent margins of the vertebral bodies with more or less destruction and collapse of the bodies.

In tuberculous arthritis of the spine there is angulation, with, usually, posterior deformity, obliteration of the joint space and body involvement. There is no bone production unless there is a mixed infection.

In non-tuberculous cases there is no angulation, no obliteration of the joint spaces and no body involvement, but there is bone production.

Coccidioidal granuloma may closely resemble the picture of tuberculous infection.

Luetic arthritis is characterized by marked periarticular swelling, thickening of the synovial membrane, fluid in the joint and a small area of periostitis.

The report of the roentgenologist should include all the roentgen-ray evidence, avoiding the use of technical roentgenology, in order that the clinician may correlate the roentgen-ray signs with the clinical evidence.

There is a bibliography of twenty-three references.

LABEAU, ROGER, AND BERTRAND, MARCEL. Uterus fifteen months after curietherapy for cancer of the neck. Destruction of the cancer. (Uterus 15 mois après curiethérapie pour cancer du col. Stérilization du cancer.) *Gaz. hebd. d. sc. méd. de Bordeaux.* Sept. 9, 1923, i, 435.

The specimen was presented which had been removed to gain access to a tumor of the sigmoid loop in the lower part. This had been subjected to curietherapy fifteen months previously.

The specimen was small and normal in form, even the neck which had been the seat of the cancer. On section it appeared healthy, but fibrous. The cervical canal appeared to be closed through a distance of 1 cm., and on transverse section of the neck no opening was apparent.

The radium application had consisted of 150 mgm. of bromide of radium in four tubes; two intrauterine tubes in tandem; two others in the lateral cul-de-sac of the vagina; filtered by 0.4 mm. of platinum, 2 mm. of gold, 2 mm. of caoutchouc; duration, seventy-two hours. The woman was fifty-seven years of age and the cancer was located on the anterior lip and cervical canal (épithélioma tubulé).

The prominent histological finding is the sclerosis which transformed this organ into a fibrous block in which the muscular bundles are replaced by connective tissue.

EISENDRATH, DANIEL N. Hypernephroma of the left kidney. Value of pyelography in early diagnosis of renal neoplasms. *Surg. Clin. N. Amer.*, Aug., 1923, iii, 1007.

The special technique used in the removal of the tumor mass was the ligation of the renal pedicle first before beginning the mobilization of the tumor itself, in order to prevent the propulsion of a possible tumor thrombus into the vena cava and from here into the general circulation.

A second ligation was so placed as to prevent the escape into the wound of particles of a possible extension of the tumor into the vein.

In the absence of hematuria and of palpable enlargement of the kidney, the only symptom which led to a suspicion of some lesion of the upper urinary tract was the presence of pain in the left upper quadrant of the abdomen and over the iliocostal space. The diagnosis was based exclusively upon the presence of a filling defect in the pyelogram which we have learned to interpret as due to the invasion of the renal pelvis by a tumor.

The author divides these tumors into those of the parenchyma and those of the renal pelvis.

In hypernephromata a metastasis is often discovered months or even years before there are localizing symptoms referable to the kidney.

Reflex Ileus. One may encounter cases in which the predominating symptoms are those of acute ileus. This may be due to a massive hemorrhage into a tumor or the passage of clots from the kidney to the bladder. It is purely a reflex condition and due to the intimate relation of the renal and intestinal innervation.

Pyelography is a method of great value, showing filling defects, distortion of the outline of the calyces, and the presence of hydronephrosis.

The veins were involved thirteen times in 86 cases reported by Block and four times in 19 cases reported by Wright. Hence, the first consideration is to prevent transmission into general circulation of a tumor thrombus.

Rehu in one case resected a portion of the vena cava itself, with tumor thrombus.

Bertwistle, A. P. A depressed fracture over the angular gyrus: clinical and radiological localization. *Brit. J. Surg.*, July, 1923, xi, 73.

The following method was devised to locate intracranial structures upon the skull:

A skull was divided sagittally with the corresponding half of the brain. Between the more important gyri were implanted pieces of copper wire moulded according to the shape of the sulci. The boundaries of the parietal bone were marked by a thin wire glued on its margin. The brain was placed in the skull and roentgenographed lying on its mesial surface, so that the picture was a true lateral one. It was noticed that horizontal sulci lie nearer the vertex than is shown in the text books. The vertical ones show an apparent decrease in length due to the convexity of the brain. This key is useful in reading roentgenograms of skulls.

It is necessary that the patient's skull should be in the same position as the key, truly lateral. This can be accomplished by placing a small lead bead in each external auditory meatus and bringing these shadows together. The base line on the skull and the key measure 8.6 and 9.1 respectively, so that all horizontal distances before translation from the skull to the key must be multiplied by $\frac{9.1}{8.6}$.

He then applies his rule to the case reported and thus locates the skull injury over the angular gyrus.

He concludes that by the use of base lines from the inion to nasion, and a constant, it is possible to localize, in roentgenograms, the area of brain involved in injuries of the skull, even though the case be that of an infant.

Joll, Cecil A. Metastatic tumors of bone. *Brit. J. Surg.*, July, 1923, xi, 38.

The object of this paper is to show that a knowledge of bone metastases, their mode of production, the types of neoplasms which give rise to them, and their special clinical manifestations is essential.

Secondary tumors in bones arise: (1) By direct extension from tissue outside of bone into its substance (not metastasis); (2) by malignant emboli through the blood stream; (3) by extension through lymphatic paths. This third method requires a knowledge of the lymphatics of periosteum, bone and bone marrow.

The author believes that bone metastases are blood borne. He also makes the statement that squamous carcinoma has a tendency to produce secondary deposits in bone, which is not generally appreciated.

He then gives numerous cases with illustrations, and a bibliography of ninety-two references.

Friedman, J. C., and Strauss, Sidney. Observations on changes in the size and shape of hearts during the progress of compensation. *Arch. Int. Med.*, Oct. 15, 1923, xxxii, 601.

The lack of exact measurement in past studies on variations in the size of the heart is the reason for this study.

The heart in decompensated chronic lesions was first percussed. The borders so located marked with lead markers and teleorentgenograms made so that percussion errors might be visualized and more exact data be obtained. Two main points were determined: First, the so-called transverse diameter of the heart; and, second, the heart outline. It seems to be established that this diameter taken in conjunction with the heart outlines furnishes the most reliable evidence of change in heart size.

Twenty-one cases of chronic endocarditis and myocarditis were observed; 11 of these had mitral disease; 1, aortic insufficiency, and 9, myocarditis. These cases were divided into three groups:

(*a*) Those leaving the hospital unimproved, whose heart outlines remained unchanged.

(*b*) Those leaving the hospital with hearts more or less compensated, and with heart outlines unchanged.

(*c*) Those leaving the hospital improved and with heart outlines changed.

The technique used to obtain a composite plate was to superimpose plates, using two fixed points, such as the junction of the transverse processes with the tubercle of the first rib.

The arch of the aorta and the lateral chest walls also served as checks in superimposing plates. In this manner heart outlines of any number of films may be drawn on a single one for comparison.

One conclusion is that cardiac compensation may be restored without any change in any diameter of the heart, with changes only in the great vessels, especially in the superior vena cava and pulmonary artery.

A total change of 1 cm. in the transverse diameter is within the limits of roentgen-ray error. A change of less than 1 cm., when accompanied by change of shape, may have considerable significance.

The most frequent change is that of the base, namely, the superior vena cava and pulmonary artery. This variation cannot usually be determined by percussion. Decompensation occurring more than once may be due to affection of different parts of the heart, although the clinical symptoms are the same.

In chronic heart disease there may be marked variation in function, with slight or no variation in size.

Kingston, John J. Notes on the *x*-ray treatment of whooping-cough. *Calif. State J. M.*, Oct., 1923, xxi, 429.

This is the history of 24 selected cases of whooping-cough, in children from seven months to thirteen years of age.

They were given from one to three exposures, at weekly intervals, of one-fourth the erythema dose—20 ma. min., target skin distance 12 in., 9¾ in. spark-gap, ¼ mm. cu. filter—over large areas of the chest, both front and back. The duration of the disease was from three days to one month when treatment was instituted.

In the whole group before treatment there were from 445 to 489 paroxysms daily; after one treatment there were from 218 to 245, or 49 to 50 per cent of the previous figures; after two treatments, 65 to 74, or 15 per cent of the original figures; and after three treatments, 9 to 10, or about 2 per cent of the original figures.

Whooping ceased in 5 cases after one treatment; in 5 cases, after two treatments; in 7 cases, after three treatments; and in 1 case after four treatments.

The definite improvement secured in many patients and the prompt and almost complete relief in a few, constitute a positive gain in treatment.

A short history of the 24 cases then follows.

Soiland, Albert. The therapeutic aspect of short-wave *x*-rays. *Calif. State J. M.*, Oct., 1923, xxi, 415.

New dangers have appeared with the short wave-length of the high voltage roentgen ray. These disturbances are nausea, prostration, a changed blood picture and inflammatory, ulcerative and fibrous tissue changes in the intestine.

The blood changes and anemia are due to a deleterious biologic action on the lymphocytes, which are very susceptible. The red cells are more resistant.

The author has used deep roentgen therapy for a little over a year and feels that the time has been too short to classify the results with precision.

Reference is made to a bill allowing laymen to use this very powerful weapon in the treatment of the sick. The bill passed the legislature of the State of California, but the governor withheld his signature, due to the protests of the medical profession of the state and others, and thereby nullified the act.

Morison, J. M. Woodburn. Elevation of the diaphragm. Unilateral phrenic paralysis. A radiological study, with special reference to the differential diagnosis. *Arch. Radiol. & Electroth.*, Aug., 1923, xxviii, 72; Sept., 1923, xxviii, 111.

Unilateral phrenic paralysis is not uncommon. The author has seen 9 cases in the last two years; diagnosis confirmed postmortem twice.

In 2 cases the right phrenic was involved, and in 7, the left. Three cases occurred in secondary carcinoma of the mediastinum (1 secondary to carcinoma of the stomach, and 2 to carcinoma of the breast); 3 with tuberculosis; 2 with growth in the chest; and 1 with aneurism of the aorta.

Paralysis of the left phrenic nerve, due to a pathological lesion, presents roentgenologically the same characteristic features as Petit's eventration. It is only a question of variation in degree.

In adults the position of the central tendon is about the level of the eleventh dorsal vertebra. The right dome rises to the lower border of the fifth rib, and the left to the upper border of the sixth rib.

At birth the central tendon is on a level with the eighth or ninth vertebra. Normally the movements of the two leaflets are synchronous.

The stomach can be seen, during roentgen examination, to alter in shape with the act of respiration. During inspiration it becomes shorter and broader, the lower part of the curvature not altering its position.

The movements of the paralyzed diaphragm are reversed and the author thinks that this paradoxical respiratory movement is the cardinal feature.

In children a temporary elevation of the diaphragm is not uncommon. In temporary elevation the movements of the affected leaflet are not reversed. They are always synchronous with each other and with the other half of the diaphragm. In other words, there is no paralysis.

Examination of the stomach with the bismuth meal should rarely fail to settle the diagnosis.

Among his conclusions the author states that the diagnosis from the roentgenological standpoint rests on:

(*a*) The unbroken bowline extending high up into the thorax with its reversed movements, unless adhesions have formed.

(*b*) Free fluid level at the cardiac orifice.

(*c*) Bismuth meal examination.

There is a bibliography of thirty-five references.

Nagle, Gunther W. The etiology and importance of the cystico-duodeno-colic fold. *Surg., Gynec. & Obst.*, Sept., 1923, xxxvii, 365.

This is the occasional fold found extending from the fundus of the gall-bladder to the duodenum and transverse colon.

The folds which the author found are prolongations of the lesser omentum onto the under surface of the gall-bladder, extending to the right, across the duodenum and downward to the transverse colon where they become continuous with the anterior layer of the greater omentum.

He concludes that this ligament is a part of the lesser omentum and therefore of congenital origin. It is a source of danger in that it represents a potential adhesion, ready to thicken and shorten in response to neighboring pathological processes, and to furnish a guide and stimulus to the formation of true adhesions.

Palmieri, G. G. Latest studies on the diffusion of *x*-rays and their application to deep roentgen therapy. *Radiol. med.*, 1923, x, 313.

The aims, beyond many others, in roentgenotherapy are (1) to apply the largest possible dose to the diseased part, which is more or less deeply seated, while preserving the integrity of the surrounding healthy tissue; (2) to reduce the time of ray application. No technique can render the deep dose smaller than that touching the skin which covers the radiated area. Modification depends on dispersion, absorption and diffusion. The last factor may help to diminish and improve the deep dose. The German roentgenologists, at the present time, use the distant field to improve the quotient of the diminished dose with the effect of dispersion. But in many instances this lengthens the time of radiation considerably (ten to fifteen, or even twenty hours).

The author has constructed an apparatus which will allow short exposures for the superficial tumors and indirect radiation of the deep-seated lesions.

Many attempts have been made with paraffin, water contained in rubber bags, horse flesh, etc., to employ a covering which would be comparable to the tissues, or, with paper boxes filled with bolus alba, to obtain homogeneous distribution of the roentgen energy. The experiments have shown the rays to be less effective than the computations made regarding them would indicate. When the author used a stratum of water of 5 to 10 cm. the ionization chamber indicated a marked diminution in comparing the rays above and below the water, and a marked improvement when the paraffin filter was applied at some distance from the surface, but this improvement was experienced only up to a certain point. The optimum distance from the skin for the paraffin was 5 to 10 cm. To shorten the time of exposure a collector on the principle of the Chaoul collector was added. In it the primary bundles are surrounded by paraffin.

Bertolotti, M. Radiologic study of the act of deglutition of an encapsulated bolus. *Radiol. med.*, 1923, x, 361.

The deglutition of fluids in the esophagus follows strictly the laws of gravitation, and is mechanical. The muscular contractions of the bucco-pharyngeal tract cause a siphon action.

These studies were made in the erect right anterior oblique plane. The constrictors carry the bolus to a point where the elevators of the pharynx send it to the esophageal opening.

If the mouth of the esophagus fails to aspirate it, it may be rejected to the summit of the bucco-pharyngeal canal, by means of a reflex contraction of the striated muscles of the hypopharynx, not by an antiperistaltic wave. When pultaceous bolus, for instance, barium bolus, is given, no decided stop can be demonstrated; there is only an elongation of the swallowed mass; while an encapsulated bolus will make a decided epicardial stop. It passes slowly for about 4 to 5 cm., and then is suddenly projected into the air-space of the stomach. This suggests a cardial canal. It starts 2 to 3 cm. above the phrenic ring, and exends for another 3 to 4 cm. through the entire diaphragm, along the pillars formed by the anastomosing fibers of the phreno-esophageal musculature. There is, at the extreme lower end of the esophagus, an epicardial tract, 5 to 6 cm. long; by its almost entire closure it contrasts with the parts above it.

From his observations the author finds an epicardial stop, and an epicardial phase of deglutition, and a segmentary peristaltic wave in the esophageal cavity. A motor insufficiency in the esophagus is probable, and may be due to some change in the equilibrium of the mediastinal nerves.

HOWZE, CHARLES P., AND HENNESSEY, RUSSEL A. Urethral diverticula. *Surg., Gynec. & Obst.*, Sept., 1923, xxxvii, 392.

This paper accounts for a total of 80 cases, including those of the authors, and gives the division made by Watts:

A. Congenital
B. Acquired
1. From dilation of the urethra due to—
  (*a*) Calculus
  (*b*) Stricture
2. With perforation of the urethra, resulting from—
  (*a*) Injuries to the urethra
  (*b*) Rupture of abscesses into the urethra
  (*c*) Rupture of cysts into the urethra

There is a further division of true, with lining of mucous membrane, and false, without it.

The authors report Bumpus as saying that the diverticula of the posterior urethra are probably always of the acquired type.

They report a case with a stone in the bladder and one in the diverticula of the posterior urethra.

PIERGROSSI, L. For a more rational method in dosing in roentgentherapy. *Radiol. med.*, 1923, x, 279.

An apparatus which is to give satisfactory results as to exactitude and rapid reading must fulfill the following requirements: Independently from the type of apparatus and tube, it is necessary to state in a constant manner the shortest wave-length contained in the bundle of rays must be indicated with the notation λ min. It must indicate the time necessary to obtain the skin dose, which cannot be surpassed, without reaching the erythema dose—the relative deep dose, obtainable by a definite distance, filtration, and a definite field of radiation.

Simple and practical roentgenologic dosimetry must be based on (1) direct measurement of the wave-length, by means of the spectrometer, and (2) the measurement of the relative deep dose, which depends on the λ min., the type of filter, the surface of the radiated field, and the focus-skin distance. They may be measured by the ionometer (iontoquantimeter), or more simply, with the brom chart, which is described, and is similar to Kienboeck's bromo strips. Pure wax blocks are used to determine the strength of the dose. The Sabouraud Noiré paste is used in determining how high a dose the skin will tolerate. After establishing the λ min. the relative deep or superficial doses are determined.

PIRAZZOLI, A. The "oculo-esophageal" reflex in tumors of the esophagus. *Radiol. med.*, 1923, x, 415.

In the July, 1921, number of the same journal the author had published the observation of an oculo-esophageal reflex in a number of patients who were suffering from esophageal dilatation, the so-called idiopathic distention, or from cardiospasm, where the thickening of the mucous membranes and the elastic fibers still permit of a vagus reaction. Pressure upon the eye-ball called forth the reflex. The present studies made on 5 patients with neoplastic formations in the esophagus showed that the reflex is not found in this type of disease, and this absence is recommended as a diagnostic aid in differentiating between spasm and neoplasm.

ROCCHI, G. Roentgen apparatus with continous secondary tension. *Radiol. med.*, 1923, x, 289.

A transformer of high tension with an alternating current is described, with two batteries of condensors, in which the feeding circuits are inserted in opposite directions, four thermoionic valves, placed in a manner to supply the two condensor batteries always with current of the same polarity. The two accumulator batteries are arranged in series, and introduced into the circuit of a Coolidge tube, with a tension double that of the feeding tension. If the transformer has 125,000 volts that in the tube has 250,000 volts, so that the current becomes continuous and practically constant. The milliamperage in the above named tension in a normal apparatus may amount to 10 ma., so that four tubes can be supplied simultaneously with about 2.5 ma. each. A self inductor is placed in the series of the first transformer, and the tension is regulated by the variations of value in it.

Podestá, V. The radiologic picture of the cerebral ventricles injected with gas, and its diagnostic value. *Radiol. med.*, 1923, x, 371.

According to the publications of Dandy and Bingel pneumoventriculography has been used in a vast number of cases, especially in Germany, where reports were made at the Congress of Surgeons, at Berlin, in 1922, at the Neuropathologic Congress, at Halle, and the German Naturalists' Congress at Leipzig.

The spinal route and oxygen were given the preference. Its diagnostic value has been advocated in cerebral tumors, in hydrocephalus, for the differentiation between cerebral and cerebellar tumors, and to show up lesions in the cerebral cortex. Much experience is necessary to use this diagnostic aid intelligently.

Failure in making a pneumoventriculography is generally interpreted as a sign of existing closure between the subarachnoid space and the ventricles.

In Italy, Grotan, of Trieste, was the first to report 2 cases, with autopsy control. In 1 a tumor existed at the base of the cranium, at the point of origin of the dura mater. The frontal lobes were involved. The right lateral ventricle was shown to be compressed by the tumor. The second case was that of tuberculous meningitis with multiple tubercles in the cerebellum. The failure to inject gas was probably due to the rigidity of the ventricular walls.

At the second reunion of the Ligurian Radiologists, in May, this year, Bertolotti reported ependymal meningitis in a lateral ventricle. The roentgenogram had shown the difference in size of the two ventricles. Erroneously this was attributed to a tumor of the pons. Generally the method is considered without danger; 5 cases of death have been reported. In 1 of these instances the gas was introduced directly into the ventricle.

In almost all cases vomiting, headache (usually frontal) weak pulse, vertigo, and pallor were experienced. The method is contraindicated in alcoholism and arteriosclerosis. The gas is generally expelled within six to ten hours, but the ventricle often remains dilated for two or three weeks.

As a therapeutic measure it has been used in hemicrania and epilepsy. The former was not improved, but in epilepsy some improvement was seen. In 1 of these cases the fits ceased for a period of five months.

Nicolis, S. Study on the humerus varus. *Radiol. med.*, 1923, x, 277.

In the last fifteen years Bircher, Angeletti, and Merlini have studied the direction of the upper portion of the humerus. The direction of the epiphysis in relation to the diaphysis is governed by the measurements of two angles, one which the axis of the epiphysis forms with the axis of the diaphysis (axis of inclination), and an angle which is formed by a line passing through the base of the femoral head in the lower, and of the humerus in the upper, with the axis of the diaphysis (angle of direction).

In a normal humerus the inclination angle is about 135° and the direction angle about 45°. When the direction of the humeral epiphysis tends to drop with relation to the diaphysis, a state like that in coxa vara is found. The angles of inclination and of direction diminish. This state was found by Bircher in cretinism, and by Merlini in achondroplasia.

The author examined a patient who was somatically and mentally under-developed, for a tumor of the humerus which was suspected to be a secondary formation of a thyroid tumor. The roentgenogram showed the angle of inclination reduced to 120° and the angle of direction to 36°. The upper margin of the greater tuberosity reached beyond the transverse line which passed through the superior border of the head of the humerus. The head of the humerus did not show the regular spherical formation, but was flattened above, and bulged below. The varus formation is not limited to the head, but extends to the meta-epiphysis.

Saraceni, F. Balancing or pendulant movements through the sphincters. *Radiol. med.*, 1923, x, 233.

The author had occasion to observe spontaneous pendulant movement in the pyloroduodenal region of 3 patients. In the first of these cases he could observe an insufficiency of the ileocecal valve in consequence of these movements, which were more alternating than balancing. The 2 other patients presented pendulant movements in the stomach and duodenum. In these 2 cases the pendulant and balancing motion was quite pronounced. It is evident that in this portion of the gastrointestinal tract the motion would be visible and lasting. It is not the same in the ileocecal portion where the ordinary movement is less energetic and not as rhythmic as in the stomach. There are no peristaltic and antiperistaltic waves which follow in regular series or groups, but small peristaltic haustral and larger long waves with rapid sequence. The pendulant motion in this section of the intestine greatly varies in character, large and powerful waves following rapid small displacements.

The most interesting feature of the observation was the participation of two different cavities, which had different, even antagonistic functions, in this pendulant flow.

The insufficiency of the sphincter was quite explicable on the ground of the existing cirrhotic cancerous hardening. In a patient with duodenal ulcer the insufficiency was functional rather than mechanical.

Saraceni, F. A special case of pes varus equinus. *Radiol. med.*, 1923, x, 324.

The observations made on a child seven years of age led to the conclusions that: The participation of the head of the fibula in the function of the knee is not a pathognomonic sign of achondroplasia, which certain authors have stipulated. Tibialization of the fibula takes place, for the fibula fully substitutes the function of the tibia. An inferior tibiofibular diastasis makes possible and facilitates this reversion of function. The increase in the various segments of a joint, just as in any other part of the body, is the greater and the more marked according to the development and importance of the part.

The body weight, in pes varus, is to the greater extent, transmitted to the base of the fibula. The fibula in the case reported was much longer than the tibia. The upper epiphysis is larger than on the other side. It is cone-shaped, and turns somewhat toward the median line. In its upper pole it is about on the level with the superior epiphysis of the tibia. The density of the fibula is much greater on the deformed side, expecially at its base. The tibia, in its upper two thirds, is not vertical in direction, but oblique, being directed inward at the base. This is compensated by an external convex curve in the middle third.

Muehlmann. On stimulating radiation. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, 71.

The author used the so-called irritative doses ("Reizdose") on the thymus in psoriasis of all types and ages, but without good results. The spleen was treated in the same manner in a case of morbus maculosus, which had been absolutely uninfluenced by clinical treatment. After giving roentgen treatment the patient was perfectly healed, and has remained well for two years. If severe secondary and genuine pernicious anemia have not passed the possibility of reaction, the general condition is very favorably influenced by the stimulating dose. If hemoglobin was reduced too far, for instance to 10 per cent, no results were expected. Even cases that did not react to blood transfusion and arsenic in high doses were benefited.

The results in acute inflammation of the kidney with typical retention of urine were excellent. Two cases are reported which show the efficacy of this method. Clinical measures had failed in severe anemia and in reflex anuria where one kidney had been removed. In nephrosis results were good.

Piccaluga, N. On cure of hemorrhoids by radiotherapy. *Radiol. med.*, 1923, x, 419.

Hemorrhoids are inflammatory processes in the vessel walls. The vessels are dilated and infection takes place. The desired effect of treatment—except that of surgery—is the decrease of inflammation, sclerosing of the tissues, and resorption of the changed parts. Cicatrization is desired.

For roentgenotherapy these patients are placed on the table with knees flexed upon the thorax. The anal region is exposed as much as possible and washed with benzene and ether. Metallic iontophoresis is employed. A 1 cm. layer is used to delimitate the field of about 4 by 6, or 6 by 8, according to the extent of the hemorrhoids. The cotton is moistened with a one-half per mille solution of succinimid of mercury. Over the cotton a strip of tin foil is placed which unites the positive poles. The negative pole is, as usual, leaden, and the cotton placed on it is moistened with water and applied to the sacral region. A current of 30.46 volts, 10 to 15 ma. is used which the patients tolerate very well. During the last minutes of the iontophoresis, radiation is applied with a filter of ½ mm. Zn; 3 mm. Al., 200 kv., 2 ma., at a distance of 30 cm. The irradiation is made with 40 to 60 per cent of the erythema dose. The treatment is repeated two or three times, with intermissions of about fifteen to twenty days, and the dose is reduced to 20 per cent.

Seventeen cases treated in this manner, with good results, are reported. The only complication to be guarded against seems to be the undue absorption of mercury, which may cause renal lesions.

Milani, E. The functioning of the small intestine (jejunum) studied in a seriograph. *Radiol. med.*, 1923, x, 409.

The movements of the intestines were studied in 1872, on the open abdomen of animals bathed in physiological saline solution, at a temperature of 38°C. The peristaltic, pendulant and (by Braam-Houckgest) the rotatory movements were described. The duodenum, jejunum and the ileum differ in a physiological sense. If the small intestine measures 6 to 8 mm., its caliber varies from 3.3 to 1.5 cm. There are longitudinal and circular muscle fibers, and in its entire extent the circular valves of Kerkring stud the mucous lining.

In the roentgenograms the author has found an appreciable difference between the distribution of the loops of the jejunum and those of the ileum. The mesenteric bands have some influence on the loop formation. The jejunal peristalsis is very lively and continuous, while that of the ileum is intermittent, with long intermissions between the peristaltic actions. The jejunal loops which follow the mesenteric attachment to the left are more active than the last loops. The transporting peristalsis in the jejunum is typically precipitate. The simultaneous sudden filling of the first jejunal loop and the large curvature of the stomach are often seen in gastro-roentgenography. The movement of kneeding and mixing is characteristic of the jejunum. The rapid motion of the loops causes an appearance similar to that of a fir tree covered with snow. The contents of the loops is divided and subdivided many times. During the mixing and kneeding peristalsis a pendular motion is seen, and beside it there are small superficial movements. Between the peristaltic phases the Kerkring valves are clearly seen.

Matoni, H. H. Deep roentgen radiation of gastric and duodenal ulcers, and its success. *Med. Klin.*, Sept. 9, 1923, xix, 1220.

Deep roentgen rays were long dreaded by physicians, in the treatment of the stomach. They are, however, of great value. The author used them in gastric ulcers, watching the results for two and one-half years. The cures were clinical, all discomfort disappearing. The anatomical result has not yet been demonstrated because all the patients are still living. The diagnosis of gastric or duodenal ulcers must be established beyond doubt by roentgen examination. All gastric ulcers without stenosis, either simple or penetrating can be treated. The callous ulcers must be excepted. All duodenal ulcers, without stenosis, parapyloric conditions and pylorospasm, can be treated.

The dose given is 60 per cent of a cutaneous erythema dose, applied to the diseased area.

Complete clinical recovery was effected in 108 out of 140 (77 per cent); 19 (13.6 per cent) were much improved; complete failure was registered in 13 (9.3 per cent). Some influence, which is lasting, is always noticed on the acid secretion. Generally analgesic action soon follows radiation. Profuse hemorrhage is quickly subdued by it, and occult hemorrhage soon stops.

Altschul, W., and Spitz, A. Roentgenologic and clinical studies on primary tuberculosis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, *Kongressheft*, 22.

Exogenous infection with tuberculosis of an organism previously intact will cause the so-called primary complex; that is, a primary focus will form in some section of the lung and the surrounding lymphatic glands will be involved. From this primary focus, a chain of caseous miliary tubercles will develop in the descending lymphatic vessels. This process was often seen isolated and without involvement of the apices. These isolated caseous and calcareous foci are often found in children. Assmann has found them particularly in the the lower parts. The authors succeeded in a number of cases in demonstrating some old calcareous foci on the roentgen plate. Often, if they are not extensive, they are not easily shown up. Sometimes they are covered by the ribs and will appear in the intercostal spaces only during respiration. When the roentgen ray is employed directly one can, with some care, find them on the screen. Generally it is easier to find the lymphatic nodes than the primary focus. Normal lymphatic gland cannot be demonstrated by the roentgen ray and will, at most, produce only enforcement of the shadow formation. Those glands situated at the angle of bifurcation cannot be demonstrated with straight rays. The hilus glands on the left side are seen distinctly only when they extend laterally from the cardiac shadow, but when the patient is turned somewhat to the right, smaller ones may be seen if they are viewed in a sagittal direction, at the side of the cardiac shadow. Paratracheal glands, if sufficiently large and dense, can be distinguished. Caseous glands show up distinctly in their lighter surroundings. They will show up on account of their contents of acid calcium phosphate. The most intense shadows are due to calcareous glands. The paratracheal glands were sometimes found to be located laterally from the primary focus, and sometimes on the opposite side. The tuberculous process may extend from the primary focus down the same side, along the lymphatics as far as the venous angle, or it may cross the middle and reach the venous angle of the opposite side. By comparing the clinical and roentgenological findings one will arrive at a correct diagnosis. In the acute inflammatory stage of the primary complex the roentgen examination does not yield the same reliable results. In only rare instances will the primary focus be located clinically, and only the subsequent involvement of regionary lymphatic glands will produce distinct symptoms. Clinically, as well as roentgenologically, the bronchopulmonary glands are the most easily accessible. Active hilus glandular tuberculosis is clinically well defined. After the tuberculous process has taken its course and the glands atrophy, the primary complex is clinically no longer demonstrable. At this time the roentgen ray will show up the remnants very well.

Knapp, Arnold. Orbital changes produced by radium in cancer of the upper jaw. *J. Am. M. Ass.*, 1923, lxxxi, 1849.

As a result of radium application, definite changes may occur in the orbit and affect the eyeball. These changes, aside from deleterious action on the eyeball, suggest extension of the malignant growth. The question then arises whether the orbit should be exenterated or not.

It is, therefore, necessary to study the condition in the orbit which radium produces when applied in the treatment of tumors of the upper jaw and to compare this with the involvement of the orbit in the course of tumors of the upper jaw.

A study was made of the histories of tumors of the superior maxilla which had occurred in the General Memorial Hospital, in New York. In the terminal stages of the disease it is difficult to say when the involvement of the orbit begins. It is infrequent in the early stages and then begins through the inner or nasal wall or posteriorly through the floor. Inflammatory symptoms are absent, and the ocular muscle paralyses are not marked.

When radium has been applied the swelling anteriorly is different from the usual tumor growth and presents definite inflammatory symptoms, such as an involvement of the ocular muscles and especially of the inferior rectus, congestion of the eyeball, detachment of the retina, panophthalmitis, and destruction of the eyeball.

When radium is applied near bone tissue, which is so easily devitalized, necrosis results and infection follows. The effect of the gamma rays are long deferred, for weeks and even for months.

It is necessary to use the caustic effects of radium in these cases, as the results of radium and surgery combined are definitely better than surgery alone; yet, the possible deleterious action of radium on the orbit must not be overlooked.

Marshall, John A. Changes in tooth structure resulting from deficient diets. *J. Am. M. Ass.*, 1923, lxxxi, 1665.

Nine puppies, born Sept. 10, 1923, were segregated and fed a restricted diet from Sept. 25 until they were killed in May and June.

The deciduous teeth, apparently normal in size and shape, were not shed in the usual manner. The permanent incisors, cuspids and molars of the mandible were more generally affected than those of the maxilla.

In Dog 7, the lower permanent incisors were malposed and presented the appearance of arrested growth, so that the position in the arch, as well as contour and size of the teeth, was influenced.

In Dog 8, the bones have undergone marked degenerative changes. They can easily be cut with a pocket knife. Nearly all of the teeth have lost their attachment to the peridental membrane, and are very loose.

The surfaces of the teeth are rough in some cases, as though they had been placed in acid. In nearly all of the animals, some abnormality is evident.

It was found in many cases that the dentin had undergone noteworthy changes. Underneath the enamel cap was a mass closely resembling pulp, but there was no dentin between the enamel and this fibrous area. The soft tissue beneath the normal enamel was more firm than pulp tissue and was highly vascular. On section, the identification of both the inorganic and the organic portions of the dentin was impossible. Neither the dentin tubules nor tubular contents remained. Even the organic matrix, which is very characteristic in the decalcified section, had undergone profound changes.

If, by relatively simple diet experiments, such profound changes can be wrought in a short space of time, how much more significant becomes the study of the influence of diet on the growth cycle of the organism.

The dental lesions noted are: First, "caries-like" defects; second, loss of the attaching tissues of the teeth, or of the teeth themselves; third, fracture of teeth, and, finally, pulp exposure and the production of osteodentin.

Hart, W. E. Phytobezoars. *J. Am. M. Ass.*, 1923, lxxxi, 1923.

There are four varieties found in the human being:

1. The trichobezoar, or hair ball.
2. The trichophytobezoar, consisting largely of hair and vegetable matter balls.
3. The shellac concretion is found in those who use shellac varnish as an intoxicant.
4. The phytobezoar, or food-ball.

Eight cases are reported; 6 were composed of the seed of the persimmon; a quantity of celery fibers were in the seventh, and prunes and raisin skins and stems in the eighth.

With the ingestion of the barium meal, the mass is likely to be seen in the antral portion of the stomach, depending somewhat on the size, as a clear round shadow, or light area, in the darker shadow of the barium. The appearance may suggest a large bubble or filling defect, which may be seen to rise out of the antrum and float to the surface of the meal. Pressure over the stomach may displace the mass which may rise above the level of the barium, showing as a rounded shadow in the clear air space in the fundus of the stomach.

When the bezoars are large, the meal may be seen to form a cap covering something in the stomach and to canalize along the greater or lesser curvature, between the mass and the stomach walls.

As the stomach empties, the barium streaked mass may be seen in the lower part of it.

Gerin, Liautard and Chauvin (Marseille). Diaphragmatic hernia of the stomach from war wound. (Hernie diaphragmatique de l'estomac par blessure de guerre.) *J. de radiol. et d'electrol.*, Oct., 1923, vii, 452.

Diaphragmatic herniae following trauma, are yet considered exceptional accidents and the profession is not sufficiently informed of their relative frequency. The functional signs are absolutely insufficient to lead to a definite diagnosis of diaphragmatic hernia.

On the other hand, this condition should be considered when a wound of the diaphragm is suspected in the presence of digestive disturbance. Having this in mind, in the course of an examination of a wound of this character, leads to having the roentgenological examination made.

The author relates an unusual case of diaphragmatic hernia. In this case, a soldier was wounded on September 15, 1914. The shrapnel ball entered four fingers' width below the top of the left axillary space and was removed two fingers' breadth above the umbilicus, close to the median line.

He was treated for a slight hemorrhage, some pleural effusion, some peritoneal reaction, but presented no symptom of diaphragmatic hernia. Toward the end of the first week, when he had more substantial food, he was seized with severe epigastric pain, which became exceedingly violent, as if he were torn by a saw. This pain, of variable intensity, increased regularly after food. At the end of these painful attacks the patient complained of pain in the shoulder on the same side.

These serious digestive troubles were associated with painful sensation of burning. The appetite was partially preserved. The patient ate only milk and soup.

After food, he felt his pain continue and increase to a racking sensation and a swelling in the lower left thorax. These sensations increased for an hour and then slowly ceased unless relieved by a vomiting spell two or three hours after food. The pain resembled somewhat that of angina pectoris. A slight cough was present, but without expectoration. It was rare except during the attack.

On the roentgenoscopic screen the left base of the lung was absent and the contour of the diaphragm on the left was absolutely unmarked.

A round clear zone appeared in the gray of the left lung base resembling the gastric air pouch, but the diaphragm was elevated to a level above the horizontal track of the middle part of the heart shadow. The heart was much displaced to the right.

With the opaque meal, the bolus descended in a normal track until it reached the stomach where it spread, but singularly the pocket filled from below and not from above.

The cardia corresponds to its lowest point. The bolus descended in the esophagus alongside the length of the stomach, penetrating it at the bottom.

When the entire opaque meal was swallowed the stomach presented the appearance of two round pouches, one above the other. The inferior, the larger, entirely opaque, appeared to be in the normal position of the large end below the diaphragm. It was connected to the upper pocket by a narrow conduit clearly marked on the screen, obliquely upward to the left, which opened up suddenly to end in the second stage of this double stomach.

This upper one was entirely intra-thoracic. It is opaque in its lower fourth but is clear in its upper three-fourths which corresponds with the gastric air chamber.

This two-stage stomach, the one abdominal, the other thoracic, emptied itself with normal rapidity. When a certain part of the barium meal was evacuated, an air pocket appeared in the lower loculus while the lower part of the thoracic stomach remained opaque. Then the upper part emptied itself completely, and finally the lower part. We undoubtedly had a diaphragmatic hernia with part of the stomach in the thorax. The patient refused operation.

Tholen, E. F. Dental impactions and their sequelae. *J. Am. M. Ass.*, 1923, lxxxi, 1664.

Eighty-four cases are reported, the majority of which had caused no pathologic changes. Forty-eight of these cases were due to infection; 23 to reflex disturbances; and 13 to postoperative complications.

Of the 48 cases, 9 resulted in osteomyelitis, periostitis and necrosis. In 1 of these there was a temporal abscess, and another resulted in infection of the temporomandibular joint, with necrosis of the temporal bone. Death resulted.

In 35 instances there were evidences of rarefaction of bone about the teeth, and some general infection.

There were 2 cases of maxillary sinusitis from upper third molar impactions.

One case of chronic lymphadenitis of the right submaxillary group was cured by the removal of an impacted lower third molar.

The second group included only those in which the reflex symptoms were relieved by removal of the impactions.

There were 10 cases of neuralgia of one or more branches of the fifth nerve. There were 4 cases of cysts, 3 being in the mandible.

Of the 84 cases, 45 were mandibular; 32 were of the upper third molars; 6 were upper canines and 1 lower bicuspid. (One upper and one lower second molar were included in the above.)

A majority of impactions do not give rise to pathologic lesions. A minority give rise to very serious lesions.

The roentgenogram is often over-rated. Each case requires close study and weighing of all factors.

Galob, M. A survey and interpretation of the spastic phenomena of the gastroenteric tract. *N. York. M. J.*, Nov. 21, 1923, p. 633.

The spastic phenomena are discussed under cardiospasm, gastrospasm, pylorospasm, duodenal spasm and enterospasm.

The innervation of the esophagus is derived from the vagus and from the sympathetic. The stomach is innervated by the cerebrospinal system, and the sympathetic; with the former, through the medium of the vagi, with the latter by the splanchnics through the solar plexus. The nerve supply of the intestines differs, however, as it consists mainly of nerves from the sympathetic with a few filaments from the vagus, and in addition the ganglia of Auerbach and Meissner—those of Auerbach residing between the muscular coats, and those of Meissner in the submucosa; both belonging to the sympathetic system.

In the esophagus, there are five points of constriction: (1) At the introitus, (2) at the aortic arch, (3) at the crossing of the left bronchus, (4) at hiatus esophagi and (5) at the cardiac opening. The entire epicardia, that is, the portion of the esophagus below the diaphragm, is distinctly narrower than the rest of the esophagus.

When dysphagia presents itself the question arises whether we have a neurosis or a symptom of structural pathology. If the former, we usually have as an accompanying symptom a complaint of substernal soreness. A history of long duration would complete the triad of esophageal neurosis. This, if allowed to persist, may be the precursor of structural changes.

Cardiospasm and spasm at the cardia: Cardiospasm includes hypertrophy at the cardiac sphincter with general diffuse dilatation of the esophagus. The spasm at the cardia is but a transient condition and has neither hypertrophy nor dilatation of the esophagus.

The roentgen ray shows signs of a pathological condition, from a hesitancy to a complete stoppage. The roentgenographic shadow appears as a regularly conical obstruction at or near the cardia with a secondary dilatation above it.

Cardiospasm and malignancy at the cardia can be differentiated by the roentgen ray by the following sign-complex of the latter: (1) Delayed esophageal evacuation; (2) distortion of the gas bubble; (3) distortion of the cardia, and (4) elevation of the left diaphragm. Dilatation is absent in malignancy, except for a slight dilatation above the point of constriction. Syphilis, and more particularly cardiospasm, produce a markedly dilated esophagus.

The stomach is not a static organ, passive in vocation, but a functionating dynamic apparatus sensitized to respond to stimulus from any source. Heyd summarized 100 cases of spastic phenomena of the stomach in which 20 per cent were due to organic disease of the stomach; in 40 per cent the lesion was within the abdomen, but remote from the stomach, and in the remaining 40 per cent, the pathological process resided entirely without the abdominal cavity.

The principal source lies in the vagus and sympathetic nerves.

An indispensable aid in the study of spastic troubles of the digestive tube is the roentgenological study with the opaque meal.

Roentgenographically, pylorospasm is manifested by a sharply cut off pylorus, total or partial retention of the motor meal, a deep-cutting peristalsis of the 6–8 cycle type with its activity confined to the pyloric region, a transient hour-glass contraction, and finally, occasional deep incisura at the pylorus. This last manifestation must not be confused with the normal incisura at the pars pylorica and pars cardia, which, of course, are not spastic manifestations.

Kurtzahn. Changes in the human urinary tube after contrast filling. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, xxviii, No. 4.

The author uses the tube underneath the table, dorsoventral direction of the radiation. The examination is made with the patient in the oblique position at an angle of 10 to 20°; often in addition the angle is increased to 45 to 90°. The urethra is filled as follows: A Nélaton catheter is introduced about 3 cm. into the urethra, and the urethra pressed down tightly on it with two fingers. It is then possible to inject the contrast material under pressure into the urethra with a 10 c.c. syringe, without having any of it escape along the sides, and this is of great aid in cases with narrow strictures. By the use of injections of varying temperatures, below and above body temperature, the bladder sphincter can often, but not always, be relaxed so that a part of the contrast material can enter the bladder. The author has never seen any injury with this method. Air vesicles are prevented. The author's illustrations show the normal urethra, the narrowing of its lumen, due to crushing injuries, urethral fistulae, and the so-called false passages. The author emphasizes the advantages of the roentgen examination over the use of sounds in cases of fistulae and false passages. He also considers it less injurious and less difficult than endoscopy.

Friedmann, R. Diverticulitis of the large intestine. *Archiv. f. klin. Chir.*, 1921, xcvii, 564.

The author reports briefly a case of acute peritonitis following perforation of a diverticulum in the S romanum. The diagnosis of "acute diverticulitis" is very rarely made. The symptoms are the following: Usually the patients are men, aged forty-five to seventy years, who have a sudden attack of abdominal pain and vomiting; the fever is usually slight. The pain is always on the left side. The mortality is high, and treatment is necessarily operative.

Liek, E. Death following roentgen burns in deep *x*-ray therapy. *Deutsche med. Wchnschr.*, 1921, No. 34, p. 999.

The author reports on roentgen-ray burns in his clinic; in 382 cases submitted to deep *x*-ray therapy, there were 12 cases of burns of the second degree and 3 of burns of the third degree. Among the latter 3 (the clinical history of which is given in detail) there was one patient who died owing to the breaking through of roentgen ulcer into the abdominal cavity, with resulting acute peritonitis. The author believes that it is necessary to take into consideration a varying sensibility to the roentgen rays in different individuals, and advises that under carefully controlled technique a test radiation of the skin should be made in each case; also that the physician himself should carefully control all the details of the technique and never entrust these to the nurse.

Sanlader. Duodenojejunal diverticula: operated case. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, xxviii, No. 5.

Reports a case in a fifty-eight-year-old patient, who since childhood had had slight gastric pains and a feeling of fulness and pressure after meals. August, 1920, after heavy lifting, he reported pain over the umbilicus, and frequent eructations, but no vomiting, after meals and after a long walk. The roentgen examination showed complete emptying of the stomach in six hours. Slightly below the navel, practically in the mid-line, a round, sharply defined shadow was shown, the size of a small coin. A new opaque meal and a second examination showed that this shadow had no relation to the stomach; it remained visible twenty-four hours after it was completely filled. At operation a sac-like protrusion was found in the lowest portion of the duodenum in the region of the duodenojejunal flexure. After separating the peritoneum above the flexure, it could be mobilized, and the protrusion smoothed out. The patient made a good recovery, and after the operation was entirely free from symptoms. The postoperative roentgen examination showed normal passage of the opaque meal through the duodenum and jejunum and no signs of the shadow of the diverticulum that had been previously visible.

Sgalitzer, M., and Hryntschak, Th. Roentgen investigation of the bladder in the lateral position. *Ztschr. f. Urol.*, 1921, xv, 10.

It is possible to demonstrate the bladder roentgenologically when it is filled with a contrast material, from the side through the long pelvis. The diastolic bladder from this direction, if filled up to 50 c.c., presents the roentgenogram of an equilateral triangle, not very high and with its base toward the head. The walls of the bladder, which correspond to the sides of this, are described as the roof of the bladder, rectal bladder wall, and symphysis wall. If the bladder is more completely filled, the forward angle of the triangle spreads out and forms a fourth side, which corresponds to the other bladder wall. The internal orifice of the urethra does not form the lowest part of the bladder, but the angle of the triangle opposite the base, which the author calls the bladder sinus. The urethral orifice is above and behind the bladder sinus, in the region of the rectal bladder wall. The change of the diastolic into the systolic form of the bladder by strangury is shown in the lateral roentgenogram by a straightening out of the anterior and posterior angles of the bladder.

Popowski. Radium treatment of leucemia. *Strahlentherapie*, xii, 1085.

Three cases of leucemia were favorably influenced by means of 13.95 mg. radium element, which was distributed over a surface of 9 sq. cm., and filtered with 2 mm. lead; the application being continued twenty-four hours during ten days, in the splenic region, and ten hours during ten days, over the sternum. A case of erythremia was likewise benefited by means of the same quantity of radium.

Pasteau. Diagnosis of extra-renal radiographic shadows by pyelography. *Bull. Soc. franc. d'urol.*, 1921, ix, 5. *J. d'urol. méd. et chir.*, xii, 29.

Four rounded shadows, arranged in the form of a rosary in the region of the kidney, were recognized as situated outside of the kidney, by means of pyelography and exposures made in different planes. The condition presumably was biliary lithiasis. No operation was performed

Marion, G. A new case of pseudo-calculus of the ureter. *J. d'urol. méd. et chir.*, xii, 32.

A patient, forty-one years of age, presented in the *x*-ray film a shadow 6 to 7 cm. in length, and 1½ cm. in width, on the right side, at the level of the third and fourth lumbar vertebrae, touching with its mesial side the tips of the transverse process. The right kidney was removed on account of tuberculosis. The ureter did not reveal the cause of the shadow formation, but the sheath of the psoas muscle contained a chalky caseous mass which was closely connected with the psoas fibers. It was removed by means of the knife from its connections with the psoas. This mass is interpreted by the author as an old healed cold abscess in the psoas sheath. Its starting-point could not be established.

Meyer, Fritz M. The treatment of hypertrichosis. *Deutsche med. Wchnschr.*, Feb. 2, 1923, p. 152.

No rules can be formulated as to the extent of treatment required, past experience permitting only an unconditional statement to the effect that three irradiations of the same skin area unconditionally represent the lowest minimum amount, if a true permanent epilation is to be accomplished. When the entire face is affected by hypertrichosis, a division is made into six fields: right cheek, left cheek, right chin region, left chin region, right upper lip, left upper lip. Each field receives about 250 to 350 F of a radiation filtered through 4 mm. aluminum; the measurement is made exclusively below the filter. Between the first and second radiation series, a pause of at least, six to eight weeks is required; between the second and the third, a pause of at least, eight to ten weeks should be made. In over 50 per cent of the cases, permanent epilation is accomplished after the serial radiations. In a general way, the hairs on the upper lip are apt to be especially refractory. Under observation of the necessary precautions, any hypertrichosis can be removed without incurring the risk of permanent injury. The *x*-ray method of epilation may accordingly be said to represent an enormous advance as compared to the customary painful, prolonged, and unreliable method of electrolysis.

Täckel and Sippel. The concentration of *x*-rays; cross-fire. *München. med. Wchnschr.*, 1921, p. 604.

The problem of increasing the deep arc through secondary radiation, without markedly raising the surface dose was solved by the authors in the following way: A square water box of 7 cm. height, with a floor surface 40 × 40 cm., in which a space is left of the size of the actual radiation filter (14 × 14 and 8 × 8 cm., respectively) is placed upon the skin. In this way, a ray-collector is utilized which closely resembles the first Chaoul construction. The inner walls are lined with tin, thereby obtaining in the actual inner radiation field, the secondary radiation increase only, but not the skin dose. In addition, the customary filter of 1 mm. copper is reserved for the inner radiation field alone, while the secondary radiator is radiated through weaker filters, because the radiation in its passage through the water is automatically hardened. An increase is thus obtained of the deep dosage in the central ray-cone, without the skin dose being exceeded at any point.

Meyer, Fritz M. *X*-ray and quartz-light treatment of some sexual diseases. *Ztschr. f. Urol.*, 1921, xv, 7.

These rays act mainly as a mere adjuvant in the treatment, for example, of painful bubos, specific leg ulcer, specific alopecia, plastic induration of the penis, prostatic hypertrophy, vesical papillomata. As the treatment of choice, radiation therapy enters into consideration for condylomata circuminata and for phagedenic soft ulcer.

Aime, Paul. Roentgen diagnosis of chronic appendicitis. (Le radiodiagnostic dans l'appendicite chronique (avec projections). *Bull. et mem Soc. de radiol med. de Par.*, July, 1923, p. 199.

After five years' study of the appendix with the roentgen ray, a resumé of the author's studies of chronic appendicitis is offered.

He found that in all cases in which the appendix was not or had not been inflamed it could be seen on roentgen-ray examination, when not retrocecal. The visibility depended upon the filling with the opaque mixture. There was an alteration of filling and emptying which explained the divergent opinions of roentgenologists concerning the permeability of the appendix to the opaque meal.

These findings accord with what we know of the anatomy of the appendix. Because of the longitudinal and circular fibers of the musculature the food is mixed in the appendicular lumen as in the small intestine and the stomach. One sees on the screen the presence of peristaltic and vermicular movements in the organ, of which the mobility is truly surprising. Roentgenological studies by means of pictures taken in series at intervals of five minutes show on the first negative an appendix of closed ring form and on the next the same appendix in V shape with the branches largely open. The examination made five minutes later showed all of the opaque matter evacuated. In the first two pictures the peristaltic waves are admirably marked.

Chronic appendicitis. When the appendix is irritated, whether by a foreign body or an inflammation of microbic origin, the mucous membrane and musculature react. The organ becomes painful to palpation and in accordance with the degree, the seat and duration of the inflammation, spasms are produced which fix certain parts of the contents of the appendix, at times permitting it to dilate and gape. Often the peristaltic waves are obliterated and the shadow has rectilinear and parallel sides, as a whole or in part. The lumen of the canal may be filiform or very much widened.

When the appendix is not seen the most important roentgen-ray sign is based upon a painful, paracecal point accompanying the cecum in every position. There are a certain number of accessory signs which will strengthen the roentgen diagnosis of chronic appendicitis: First, the diminution of the diaphragmatic play on the right side. This diaphragmatic defense exists also for other diseases in the right abdomen. This explains the lessening of respiration on the right side and the modifications heard on auscultation of the lung of those in whom the general condition does not call to mind appendicitis. Second, one often finds gastric flatulency. The stomach is often drawn to the right until the pylorus is found in front of the cecum. Third, pain at a distance in the epigastrium or in the left iliac fossa is frequently encountered when palpation is made lying down. Palpation, made when erect, at times produce syncope.

Bartholomew, M. D. Roentgen-ray appearance in a case of congenital hydrocephalus. *J. Am. M. Ass.*, Dec. 1, 1923, p. 1879.

In this case abdominal examination having given rise to the suspicion that the head of the fetus was greatly enlarged, a roentgenogram was made which definitely showed the condition to exist, and also that there was a spina bifida. Fetal bradycardia existed in this case. It would be of interest to note if this is a usual result.

Bloodgood, Joseph C. Bone tumors, benign bone cysts due to central ostitis fibrosa of the unhealed latent type. *J. Radiol.*, Oct. 1923, iv, 345.

An immediate roentgenogram shows the disappearance of the normal picture of marrow and cancellous bone, the presence of a thin shell of cortical bone which is usually expanded, and a fracture through some portion of this thin bone shell.

A remarkable fact is that if no operation is performed and the fracture is treated as any other fracture, healing with complete ossification and restoration to normal takes place almost as rapidly as after a fracture in a normal shaft. The roentgenograms should be taken more frequently than in fractures through normal bone.

The healing of the bone cyst in which there has been only a slight fracture is usually not complete from one to four years. If accidental fracture takes place, healing is made more rapid. If the fracture is comminuted, complete ossification is as rapid as in the normal bone.

In the first cases operated upon, merely a small opening was made into the cysts. In later operations the bone shell was crushed. Complete ossification took place much more rapidly in the latter case.

These bones frequently return to normal after a few years. When the roentgenogram shows bone cyst and slow or imperfect ossification, operation is called for.

Candy, T. I. Radiography of the fetus in utero. *Arch. Radiol. & Electroth.*, Oct., 1923, xxviii, 146.

The difficulties in this work are as follows: 1. The thickness of the maternal soft tissue to be penetrated, causing scattering of the beam and blurring of definition.

2. The cartilaginous nature of the fetal skeleton giving poor contrast in such a thick mass of soft tissue.
3. The presence of the amniotic fluid increasing the scattering of the beam of roentgen rays.
4. Fetal movements.

The first three can be overcome by the Potter-Bucky diaphragm. The patient should lie face down on the Potter-Bucky diaphragm with the trochanters about 1 in. or so above the lower edge of the film in the cassette. The chest should be well raised on pillows with sand bags upon the backs of the thighs.

The anticathode of the overhead tube should be centered over the third lumbar vertebra at a distance of 30 in. from a 15 by 12 duplitized film with double intensifying screens. The patient is asked to hold her breath and at the same time to press down the abdomen firmly into the Potter-Bucky diaphragm. The assistant immediately applies firm, but not vigorous, compression with the compression band, and the exposure is made usually for about five seconds, using 25 to 30 ma. with a spark gap of 5½ in.

Overexposure must be avoided; brilliancy and contrast are essential in roentgenography of the fetus in utero. The best results are to be obtained by the use of standard developing solution used at a standard temperature for a standard length of time.

The roentgenogram will give positive evidence of the position of the fetus, together with evidence of its position in the mother's tissues.

Cunningham, John H., Graves, Roger C., and Davis, Tenny L. An antiseptic pyelographic medium. *J. Urol.*, Sept., 1923, x, 255.

It was found, after consideration of all possible antiseptics in connection with a pyelographic solution, that 1:3000 mercuric iodide in 12 per cent sodium iodide is the most satisfactory. Sodium mercuric iodide of this strength has a phenol coefficient of 0.033. In other words, it is comparable, on this basis, to 3 to 4 per cent carbolic acid. Used in equal amounts with a colon bacillus infected urine, it destroyed bacterial growth in two and one-half minutes. The solution retained in the mouth for a considerable period produces a salty paste, but no irritation of the buccal mucosa. Introduced into the circulation of a rabbit, it produced no significant change in the condition of the animal so far as heart, blood pressure and respiration were concerned.

Of course the final test of this solution rests in its clinical application. It is employed routinely in our clinic and thus far we have observed no immediate or subsequent ill effects or discomfort, following its use in either the bladder or the renal pelvis, even in the presence of active inflammation. The addition of the antiseptic sacrifices in no degree the value of the medium from the standpoint of the roentgen-ray density.

The use of 1:3000 mercuric iodide in 12 per cent sodium iodide solution, as an antiseptic pyelographic medium is recommended for two important reasons: (1) It reduces to a minimum the risk of introducing infection; (2) it provides some degree of positive benefit, apart from diagnosis, in cases in which infection already exists.

The solution is prepared by dissolving 1 gm. of mercuric iodide in 3000 c.c. of 12 per cent sodium iodide. The latter is made with chemically pure sodium iodide and distilled water. The final solution does not need to be boiled.

Fischer, A. On a new roentgen diagnostic method of the large intestine. Combination of contrast enema and air insufflation. *Klin. Wchnschr.*, 1923, ii, 1595.

The author introduces a contrast medium-barium sulphate bolus suspension as far up as the cecum. He then removes it entirely, or parts of it. He does not consider the removal necessary when colon ascendens and descendens are to be examined, but for the sigmoid loop and the transverse colon it is better. Air is then introduced and the contrast medium adhering to the intestinal walls renders the outlines distinct.

Laborderie, J. (de Sarlat.) Roentgenological study of tracheobronchial adenopathy. (L'adenopathie tracheo-bronchique. Etude radiologique). *Rev. gén. de clin. et de thérap.*, Oct. 13, 1923, xxxvii, 668–671.

Tracheobronchial adenopathy is a more frequent disease in infantile pathology than it is thought to be, and its early diagnosis, though difficult, can be made.

This affection is the starting point of a large number of cases of tuberculosis in the adolescent and the adult.

Treated from the beginning, these tracheobronchial adenopathies are arrested in their development and do not become favorable ground for the growth of bacilli. On the other hand, when the state of resistance is lowered by overfatigue, by excess or by infectious disease, these relight and an incurable tuberculosis is begun. Roentgen-ray diagnosis is of great value in these cases.

It frequently happens that the child is pale, in bad condition, nervous, with capricious appetite, and the mother often finds that when he plays he becomes slightly breathless, with a hard, dry, irritating cough at night.

Inspection often reveals an increase in size of the veins of the neck, which are rendered very apparent. Auscultation and percussion sounds are changed. The roentgen-ray examination systematically practiced will remove all doubt.

This may be done in two ways: (1) by the screen; (2) by the roentgen-ray plate or film.

The first permits the examination of the peri-hilum glands. The second permits the detailed study from a permanent record.

A knowledge of the normal hilum is required to interpret properly these shadows.

In an infant attacked by tracheobronchial adenopathy, hypertrophied, softened, caseated or calcified glands are formed.

The shadow of the hilum is accentuated and the superior and lower bronchial trunks appear larger, with some thickened points.

At a later stage, the ganglia appear as isolated shadows, more or less lengthened, with rounded, softened contour.

The isolated ganglia present a peripheral irradiation which makes this resemble a spider web or a star.

In other cases, the ganglia have an opacity like a metallic foreign body.

These latter are rare in children and are observed only in the last stage in which the ganglia are grouped into a more or less homogeneous group or groups.

The seat of these ganglia is at the level of the hilum, but they may also be found down to the level of the diaphragm; and in the angle of the shadow of the heart and the great vessels near the vertebral column.

An early diagnosis is important and capital importance should be attached to the roentgen-ray examination.

A few treatments suffice to cause this cough and dyspnea to disappear, and to completely cure this affection.

Larrabee, W. S. The value of *x*-ray examination in pulmonary disease. *Southwest Med.*, Oct., 1923, vii, 376.

The report from roentgen-ray examinations in some pulmonary cases is difficult to believe, particularly in supposed negative cases when marked evidence of fibrous tissue increase, with small cavities, calcified glands, etc., is present. The careful diagnostician is often in doubt if such evidence is to be trusted, but with experience, knowing the normal appearance, he learns that pathological changes can be detected with positiveness, and that the roentgen ray is of distinct value to him as an aid to diagnosis of the lungs.

Every screen examination should be supplemented by stereoscopic films. These supplement each other and the examination is incomplete unless both are used. No plate will tell the diagnostician of the action and excursion of the diaphragm, and the aeration of the apices.

The upright position is necessary only when effusion is suspected. The location and extent of lesions may be determined by the roentgen ray with a certainty and rapidity beyond the power of physical examination to approach. The film remains a permanent record for reference or comparison of cases. This method does not displace physical examination but must be considered with it. The clinical history should always go with these findings.

Many cases of tuberculosis that are diagnosed as the first stages are found by this method to be advanced. When the peribronchial shadows have a woolly outline and one apex fails to light up as well as the other, when one side is lighter than the other or when there is limitation of movement of the diaphragm, then there is reason to suspect beginning tuberculosis.

The courts have decided that the roentgenogram belongs to and is a part of the records used by the roentgenologist in arriving at his diagnosis. The physician who sends his patient in for an examination should have a detailed report of the findings and whatever additional information is seen to bear upon the case. A roentgen-ray examination is a medical consultation and should be so regarded by both patient and physician.

Ledoux-Lebard, R. Roentgenological study of the appendix. (L'etude radiologique de l'appendice). *Bull. et mem. Soc. de radiol. med. de Par.*, July, 1923, p. 197.

It must be recalled that it was in France that the possibility of demonstrating by roentgenogram, the filling of the appendix with an opaque medium, was made known. The thesis of Gourcerol reviews very completely these first observations of the first roentgenologists (Desternes, Baudon, Aubourg, etc.).

The Americans have striven with success and have shown very fine and numerous roentgenograms. (Case, Cole, Carman, George, Leonard etc.) They have fixed the technique of the examination of the appendix. Certain of them have stated that it is not always possible to show this organ unless a lesion is present.

The visibility depends perhaps upon the opaque mixture used, barium mixture being better than the carbonate of bismuth. The more often the examination is made between the fourth and the thirty-sixth hour the better the chance to get the image of the appendix. It was seen most frequently by the writer between the seventh and tenth hour and these between the twenty-second and the thirtieth hour.

If the appendix remains for a long time the only part of the digestive tube retaining the opaque mixture, it would appear to be a pathologic retention.

In the emptying and filling of the appendix it appears to be a mobility within itself rather than the application of exterior force.

LENNOX, W. G. A study of the basal and nitrogenous metabolism in a case of acute leukemia during roentgen-ray treatment. *Arch. Int. Med.*, Nov. 15, 1923, xxxii, 705.

The patient in this case of leucemia was studied for fifty days, during which time the diet was weighed and prepared by the hospital dietitian, supplying 1.4 gm. of nitrogen per kilogram of body weight, 92 gm. of fat (on the thirteenth day increased to 116 gm., and 240 gm. of carbohydrate). This yielded about 2,050 calories, which was about 10 per cent above the patient's basal requirement.

A chart is given of the leucocyte count, morning and evening temperature, basal metabolism, the nitrogen intake and output, the fat and carbohydrate calories.

Inspection of the chart reveals that the patient maintained a positive nitrogen balance of a gram or two on a normal intake of about 10 gm. a day. This showed a very low leucocyte count.

The nitrogen balance was little affected by roentgen-ray exposure of the superficial lymph-nodes. Radiation of the thoracic glands and the spleen, on the other hand, produced a marked increase in urinary nitrogen.

Leucocyte count and nitrogen balance were reciprocal factors, a rising leucocyte count accompanying nitrogen retention, and a falling count, nitrogen loss.

Leucocyte count, temperature and basal metabolism moved together. The leucocyte count was the most mobile. The metabolism seemed a better indicator of the severity of the process than the leucocyte count.

LEPENNETIER, FRANCOIS. X-rays, high frequency, and associated electrolysis in the treatment of the sequelae of cervical tuberculous adenitis. (Les rayons x, la haute frequence et l'electrolyse associes dans le traitement des sequelles de l'adenite cervicale tuberculeuse). *J. de radiol. et d'electrol.*, Sept., 1923, vii, 393.

The apparatus differs in no way from the usual form. For roentgenotherapy: a No. 2 Gaiffe table with a Chabaud ampoule or a standard Coolidge tube according to the case. For the high frequency d'Arsonval-Gaiffe connected with an Oudin resonator; the application is made with a MacIntyre electrode or a flat or rough electrode. Electrolysis is done with platinum needles containing a small amount of iridium; the current is supplied by a storage battery. Zinc electrode was used in keloids in the same laboratory by Dr. Bonte, but not by them.

Haret and Dariaux reported on this matter in the Radiological Congress of Anvers in 1920.

An opened Monoganglional adenitis or one with a recent fistula is amenable to the action of the roentgen-ray, and of high frequency: 3 to 4 mm. of aluminum overlapping half a centimeter all around, the neighboring skin being protected by lead 2 mm. thick. J. Belot counsels doubling this by a second of the same dimension within a leaf of opaque caoutchouc. This last is intended to protect the skin from the secondary radiation from the lead. This protection is reinforced by the employment of a leaf of board placed between the filters or between the localizer and the skin. The high frequency is applied with the flat narrow brush electrode or with the condensed electrode. In the first case the electrode is held by the operator at such a distance from the skin that the special hum of the continuous discharge is heard and one sees a violet light and smells the characteristic odor of ozone. These high-frequency seances should last from ten to fifteen minutes so as to cause a slight erythema of the skin. This is repeated three times a week.

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SPONDYLOLISTHESIS A COMMON LUMBOSACRAL LESION*

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SPONDYLOLISTHESIS, a term usually applied to a forward and downward dislocation of the body of the last lumbar vertebra on the first sacral, is derived from the Greek word "spondylus" meaning vertebra and "olisthesis" a slipping downward or forward. Technically, this definition may be applied to the downward and forward dislocation of any of the vertebrae. This condition, according to most textbooks, is considered to be rather rare, and recent literature contains very little reference to this subject.

The spondylolisthetic pelvis was first described by Ropitanski who reported 2 cases in 1839, although Herbiniaux in 1782 reported a case which was evidently a spondylolisthesis. Neugebauer made a rather exhaustive study of this condition and collected 90 cases and specimens. Lovett analyzed 30 cases of subluxation of the fifth lumbar vertebra, 12 of the fourth lumbar and 1 of the first sacral. Palmer[1] states that the plane of the fifth lumbar vertebra on the sacrum has a tendency to allow the fifth lumbar to slide forward, and that the only structures which prevent this slipping are the ligaments, the fibers of the intervertebral disc, the iliolumbar and lumbosacral ligaments and the ligamenta subflava of the spinous processes. Any stretching or tearing of these ligaments may produce a spondylolisthesis. He also states that he may be theorizing, but I am of the opinion that it is a fact which can now be definitely proven. Darling[2] in 1918 published an article on this subject in which he states that violence is usually the true cause of spondylolisthesis, and that in many cases symptoms are few at the time of injury. It is his opinion that the onset is gradual, and the diagnosis ofttimes is made many months after the injury.

Numerous etiological factors have been mentioned by various authorities, among which are tuberculosis, fractures, congenital anomalies, destruction of the intervertebral disc, trauma or a slight back strain resulting from lifting. Roberts[3] states that the condition is not unusual in the laboring classes doing heavy work, and that carrying heavy weights and lifting play an important part in the etiology of this condition.

My object in presenting this paper is to show that spondylolisthesis or an anterior displacement of the fifth lumbar vertebra is by no means uncommon, but is present in many cases of injury of the lower back, and that it is a condition which is seldom correctly diagnosed, due, no doubt, to the fact that not enough attention is paid to getting detailed lateral roentgenograms of the lumbosacral joint. Many of the cases of so-called sacroiliac strain or dislocation which give negative roentgen findings in that region, but which are improved or cured by manipulation by the orthopedist or attending surgeon, are, in my estimation, cases of spondylolisthesis.

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* Read at the Twenty fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

A careful study of the lumbosacral joint in all cases of pain in the lower back examined in my laboratory during several months, many of them being seen immediately after injury, shows this condition to be exceedingly common. I have seen as many as 3 cases in one week.

Many times the injury was thought to be of minor importance and the examination was made simply as a precaution on account of its being an industrial accident case. The majority of my cases, by far, were the result of a fall. In some instances the patient claimed to have strained his back. Others complained of pain following the lifting of some heavy load. A few of them mentioned the fact that they felt something give way at the time of the lifting and that they were unable to proceed with their work. Others gave a history of pain in the lumbosacral region following the cranking of an automobile or auto-truck. Two patients reported their symptoms to have followed a sprain of the back caused by slipping without falling. A few of the cases gave no history of injury whatever, but of a gradual onset which grew progressively worse. The majority of cases were encountered in men, principally of the laboring type, although the 2 cases showing the most deformity were in women. Several cases of long standing gave the history of helpful manipulation by a chiropractor. Some cases were complicated by fractures or bone lesions involving the spinal column above the lumbosacral joint. It is also not uncommon to see this condition accompanied by a congenital anomaly of the fifth lumbar or first sacral vertebra.

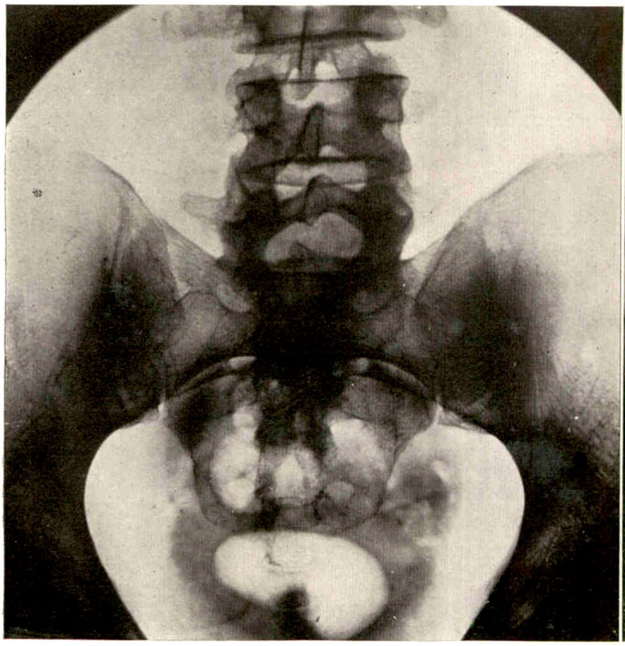

FIG. 1. Anteroposterior view of normal lumbosacral and sacroiliac joints.

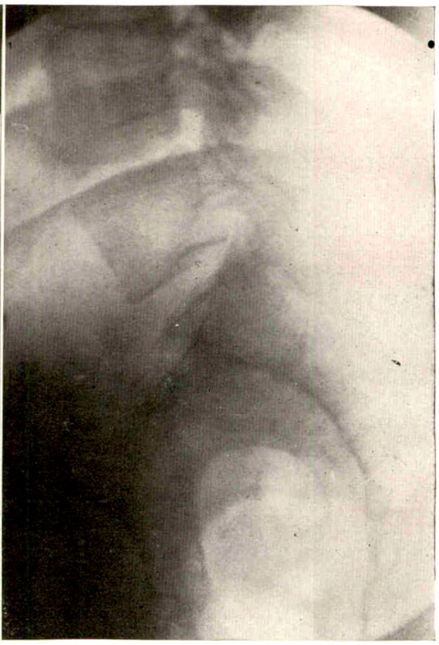

FIG. 2. Lateral view of same normal lumbosacral and sacroiliac joints.

I am of the opinion that many of these cases are accompanied by fractures of the articular facets of these vertebrae which cannot be demonstrated roentgenologically.

The technique used in the examination of this region does not vary greatly from that described by both Hickey[4] and Groover.[5]

Anteroposterior roentgenograms of both the lumbar spine and sacroiliac region are first made with the patient lying flat on his back, feet together, toes turned up. Stereoscopic roentgenograms are advised

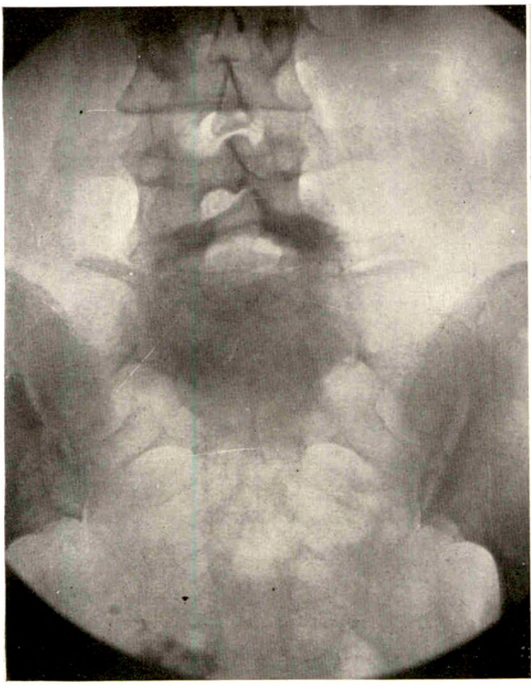

FIG. 3. Case I. Anteroposterior view.

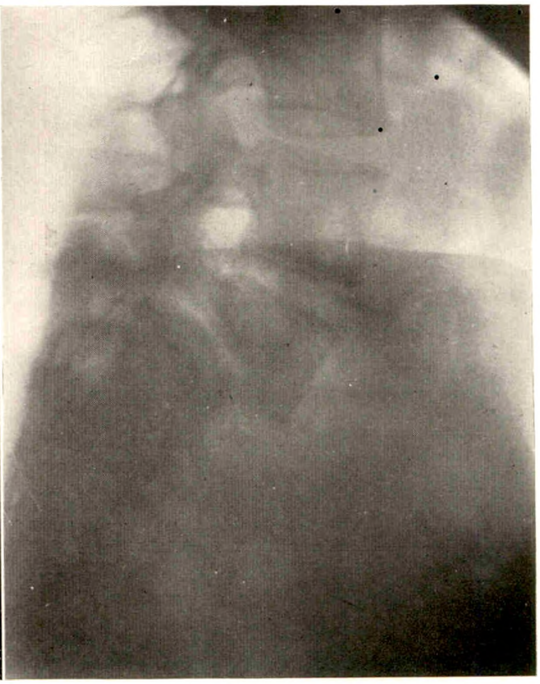

FIG. 4. Case I. Lateral view showing anterior subluxation of the fifth lumbar vertebra with partial destruction of the posterior portion of the body of that vertebra, evidently due to a pressure necrosis.

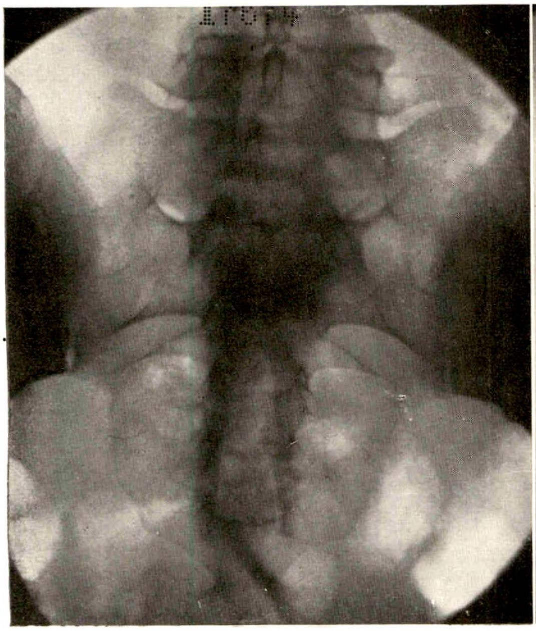

FIG. 5. Case II. Anteroposterior view.

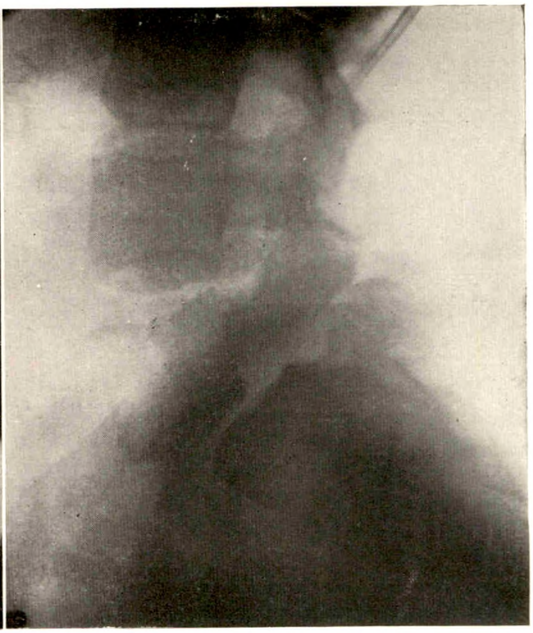

FIG. 6. Case II. Lateral view showing definite anterior subluxation of the body of the fifth lumbar vertebra.

and may be of additional assistance, but, in my own experience, I have never been able to make a definite diagnosis from the anteroposterior roentgenograms alone. Lateral roentgenograms are then made of the lumbar vertebrae and of the lumbosacral joint with the patient lying at right angles to the median plane in as comfortable a position as possible, so that there will be no movement. Occasionally it is necessary to elevate the shoulders or upper dorsal vertebrae by inserting a pad beneath the patient so as to keep the bodies of the lumbar vertebrae as nearly parallel to the plate as possible thereby eliminating a certain amount of unnecessary distortion.

One lateral roentgenogram should be made of the lumbosacral joint alone using a small cone and with the central ray passing directly through that joint. The diagnosis depends entirely upon obtaining a clear detailed lateral roentgenogram of that region.

The fact that these cases have not been diagnosed more frequently is due to the difficulty in obtaining good lateral roentgenograms of the fifth lumbar and first sacral vertebrae through the crests of both iliac bones. With the present modern equipment, super-speed films and double intensifying screens, this is now possible even in exceedingly heavy individuals.

REPORT OF CASES

CASE I (No. 6954). Female, aged forty. Five years ago slipped on wet pavement and fell backwards landing on back. Has had pain ever since, worse in sacroiliac region and radiating into both legs.

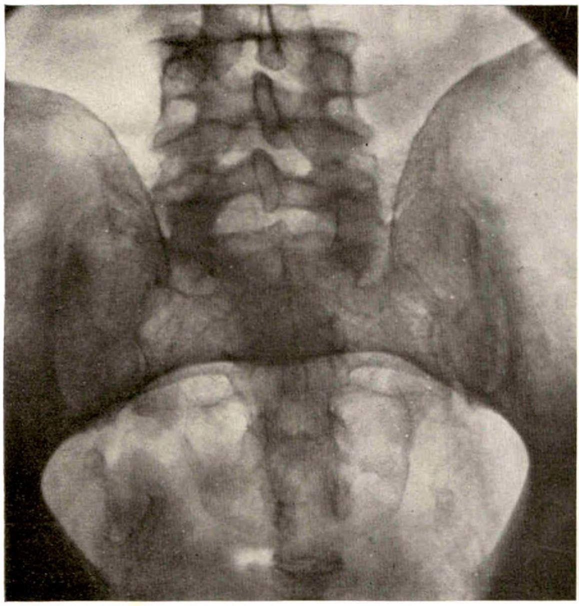

FIG. 7. Case III. Anteroposterior view.

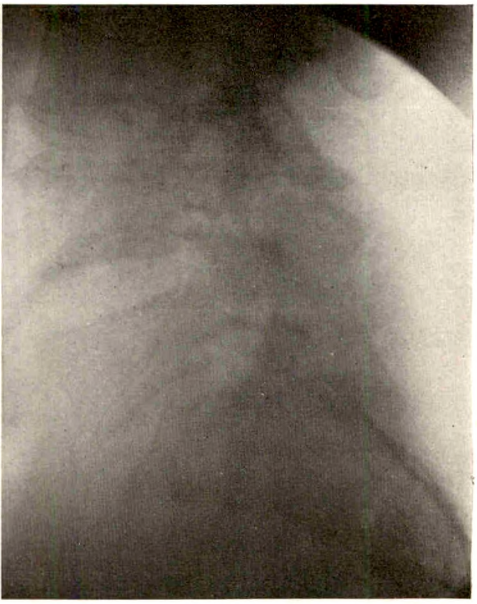

FIG. 8. Case III. Lateral view. This patient also had compression fractures of the bodies of the first and second lumbar vertebrae.

Roentgen Findings. Anterior subluxation of body of fifth lumbar vertebra. Considerable pressure necrosis of posterior portion of the body of that vertebra.

CASE II (No. 17674). Female, aged thirty-six.

Patient had no definite history of injury. Developed a pain in sacroiliac region which is gradually increasing and now radiates into right leg. Has become markedly worse last two months.

Roentgen Findings. Marked anterior subluxation of the body of the fifth lumbar vertebra.

CASE III (No. 18240). Male, aged forty-two.

Three months ago patient fell distance

of 20 ft. landing on back. Pain in dorsolumbar junction and in sacroiliac region radiating into both legs.

Roentgen Findings. Compression fractures of bodies of first and second lumbar vertebrae. Slight anterior subluxation of the body of the first sacral vertebra.

Case IV (No. 13548). Male, aged fifty-two.

Fell from six foot platform this morning, landing on floor. Pain in sacroiliac region. Worse on movement. Also pain in neck.

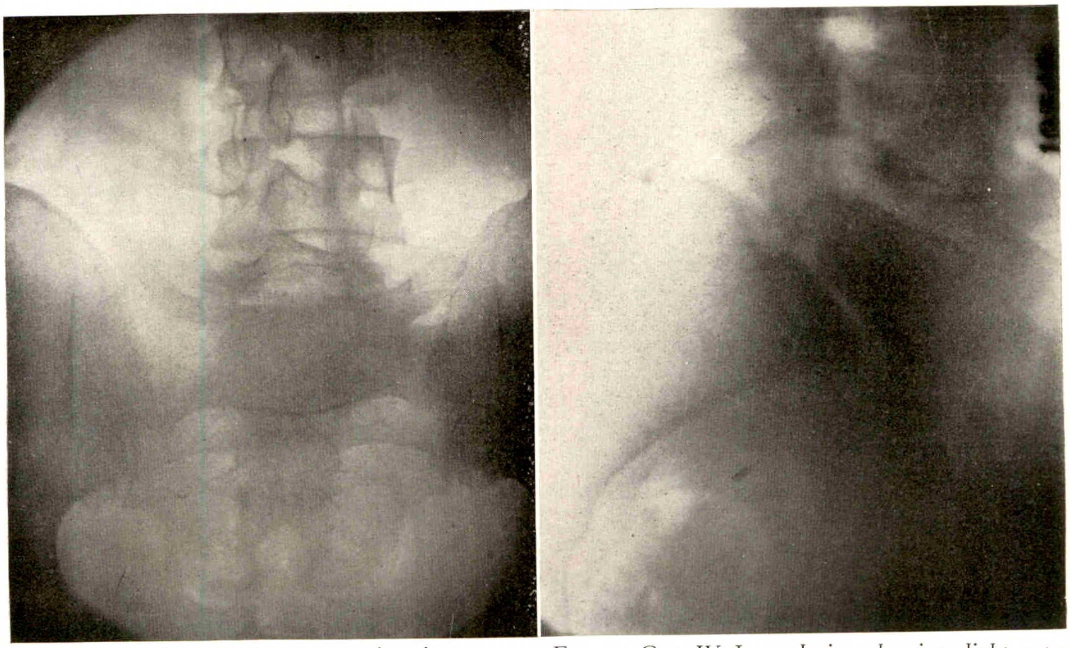

Fig. 9. Case IV. Anteroposterior view.

Fig. 10. Case IV. Lateral view showing slight anterior subluxation of the fifth lumbar vertebra.

Roentgen Findings. Anterior subluxation of body of fifth lumbar vertebra, also fracture of right articular facet of first sacral vertebra.

Case V (No. 13569). Male, aged twenty-nine.

Six weeks ago patient was on street car when it collided with truck and he was thrown from front door to center of car, landing on back. Constant pain in entire spine radiating into right leg.

Roentgen Findings. Anterior subluxation of fifth lumbar vertebra. Fracture of inferior articular facet of fifth lumbar vertebra. Partially sacralized last lumbar.

Case VI (No. 11761). Male, aged forty-four.

Four weeks ago patient fell 12 ft. from a scaffold, landing on back. Pain in sacroiliac region ever since.

Roentgen Findings. Patient has an extra sacral vertebra. Fifth lumbar is displaced slightly forward on body of first sacral. Considerable rotation of bodies of all lumbar vertebrae.

CONCLUSIONS

1. Spondylolisthesis is not an uncommon condition. It is a common cause of pain in the lower back as shown by the frequency with which it occurs in lower back injuries.
2. It is usually the result of trauma, the injury often being considered of minor importance.
3. The symptoms are often not so severe as you would expect with this type of lesion, but are prone to get progressively worse after injury.
4. Many of the cases now diagnosed as sacroiliac dislocations by the attending physician or surgeon that cannot be demonstrated roentgenologically are, in reality, cases of spondylolisthesis.
5. Clear detailed *lateral* roentgenograms of the lumbosacral region are absolutely essential in diagnosing these cases.

6. In all cases of pain in the lower back, an examination of these regions should be made.

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ABSTRACT OF DISCUSSION

Dr. Dachtler said that the condition described by Dr. Bowman is much more common than lesions in the sacroiliac region, or at least we are more able to diagnose them. He also cautioned against making a diagnosis of compression fractures of the fifth lumbar vertebra unless the evidence is absolutely convincing.

Dr. Pfahler emphasized the fact that there is such wide variation in the normal in the fifth lumbar vertebra and in the lumbosacral joints that we must use great care in interpretation of the roentgen findings.

Dr. Edmonson spoke of the necessity for the legitimate practitioner to inform himself about the treatment of these cases so that there would be no excuse for their applying to chiropractors for treatment.

Dr. Holmes said that it is a well-known fact that complete luxation of the fifth lumbar vertebra does occur and if there are complete slips, it is reasonable to believe that there are partial slips. He said that Goldthwaite and Adams had called attention several years ago to the fact that the lumbosacral joint was a much less fixed joint than the sacroiliac and that a large proportion of the so-called sacroiliac sprains are really slips of the fifth lumbar. He called attention to the necessity for getting a true lateral view and for judging the amount of displacement by the alinement at the posterior instead of the anterior aspect of the body of the vertebra.

Dr. Keith said that he had been able to obtain better lateral views of the lumbar spine and pelvis by inflating the colon with air.

Dr. Bowman, closing the discussion, verified the statement that in his experience fracture of the fifth lumbar vertebra is very uncommon. He emphasized Dr. Pfahler's remarks upon the difficulty of recognizing abnormalities in the lumbosacral region because of the many variations in the normal, and stated that diagnosis of abnormality should be made only upon demonstration of an actual subluxation. He prefers to check the alinement of the fifth lumbar vertebra along the posterior, that is, the anterior wall of the spinal canal, rather than along the anterior aspect of the body of the vertebra.

BONE DYSTROPHIES OF VARIOLA*

BY J. W. CATHCART, M.D.

EL PASO, TEXAS

TWO things seem pertinent to a discussion of bone dystrophies in variola. Is there a specific bone lesion, and if so, does it occasionally produce changes in developing bone that have distinctive roentgen-ray characteristics?

The first seems clearly and definitely shown by the works of Chiari and Mallory, and the second by roentgenograms of unvaccinated individuals who had variola during the first-age period, and who, with no history of trouble in the bone other than that present at the time they had variola, now have well-marked dystrophies.

Chiari[1] in 1891 performed 22 autopsies on variola cases, 5 concerning the eruptive stage, 9 the suppurative and 8 the drying stage of the disease. He also performed 2 autopsies on children nine years of age, who died two and two and a half months respectively, post variolum. In all bones examined, non-suppurative, sterile, necrotic foci were found in the bone marrow. The more advanced the disease, the more necrotic the foci, and in one of the children who died of marasmus, two months after recovery from variola, the autopsy notes read as follows: "Bone marrow from the right femur showed isolated nodular pale foci near which contraction of necrotic tissue had set in; obliterated structures of bone marrow substituted by fine and coarse granular detritus representing resorption process in necrotic foci."

Mallory,[2] after examining microscopically all classes of bones from 14 patients dying of variola, concludes that in variola the marrow from various bones shows more or less numerous circumscribed typical inflammatory foci associated with central necrosis due to variola infection, with the foci more numerous in the short bones.

He found that migration of leucocytes was insignificant, and no pus formation was ever observed in the bone marrow. The necrotic area was invariably surrounded by an inflamed zone with typically swollen osteoblasts and serous and fibrinous exudate. The progressive extent of central necrosis was indicated by fragmentation of the nuclei within the inflamed zone.

It seems probable that patients of the first-age period who have variola may have necrotic areas in the bone marrow so situated as to involve the ossific centers. The disturbed ossific centers may alter the future development of the bone, causing the epiphyseal cartilage to disappear and the longitudinal growth of the bone to be inhibited. The epiphysis may become altered in configuration and irregular in outline. Ankylosis, fusion and exostosis are quite frequently seen. The lesions may be multiple and may involve any of the bones and joints, although the long bones and their articulations are more frequently affected. Cases with deformities have been reported where the variolar infection occurred from three to fourteen years of age—the greater deformities occurring in the younger children.

Musgrave and Sison,[3] in 1910, reported 8 patients who were admitted to their service in the Philippine Medical School and who were suffering from deformities of the forearms and hands caused by variola contracted during childhood. In 1913[4] in a further report they state: "We had the opportunity to study several other cases of which 12 are briefly reported." Twenty cases in all were reported, 18 with photographs and 2 with roentgenograms. All were native Filipinos.

Sheldon[5] reported 2 cases with characteristic deformities in Chinese.

We have had 2 cases referred for roentgen examination in which we consider the bone lesions characteristic of variola, and through the courtesy of Dr. W. L. Brown[6] we are reporting them.

CASE I. American girl, aged six, face covered with variolar scars. Had variola three years ago while living in Mexico; was seriously ill and was in bed three months. During the last six weeks of her illness her arms and legs were so sore that she could not be moved. It was thought that she had rheumatism. She had one small abscess on the inner side of the left tibia just above the ankle joint which was opened on two or three occasions, and which healed after the bone was scraped. From the time of that illness until the present time, three years, she has been gradually developing deformities of the forearms and wrists.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

Roentgen Report. Left forearm: Ulna extends approximately 2 cm. beyond the radius deflecting the hand sharply to the radial side. There is an area of decreased density involving the lower end of the diaphysis for a distance of 2 cm., which is suggestive of old necrosis. Radial shaft slightly bowed and thickened. The distal epiphyseal line is obliterated and the articular surface appears small and forced back into the shaft, with the shaft partially overlapping it.

Right forearm: Bones forming the elbow-joint appear normal except for obliteration of the radial epiphysis. The shaft of the radius is bowed outward. The lower epiphyseal lines of the ulna and radius are obliterated at the wrist. The articular ends are irregular and uneven in outline; the shaft overlaps slightly the impacted articular end of the bone.

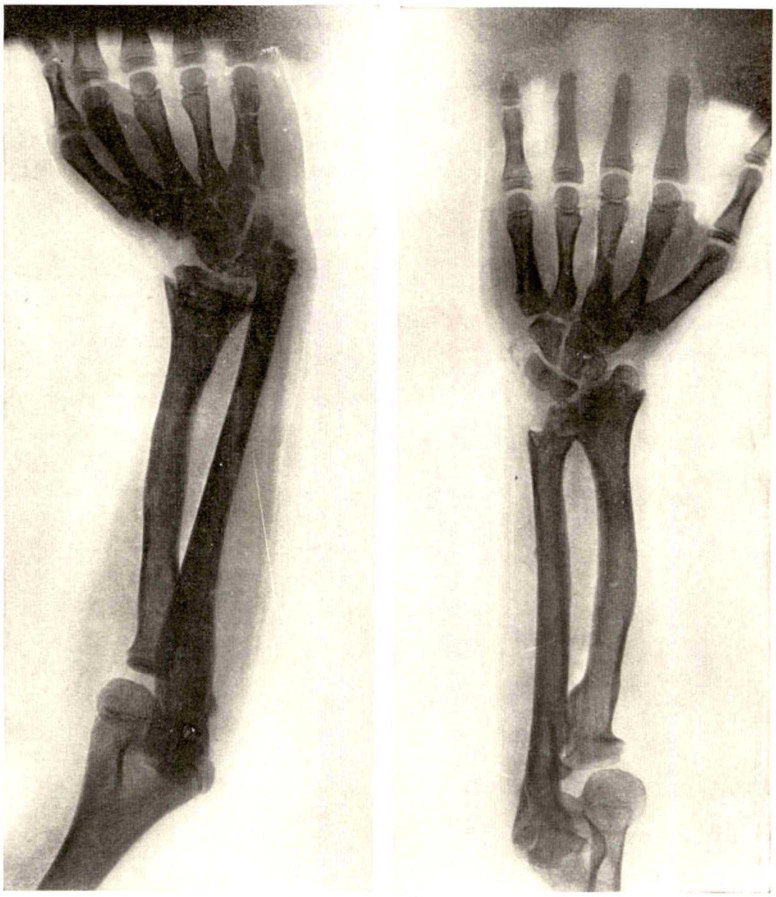

Fig 1. Case I.

Left leg: Evidence of old necrotic area lower outer aspect of tibia. Light area suggestive of necrosis in fibula 5 cm. above tip of malleolus.

Right clavicle: 2 cm. shorter than the left. Outer articular end is small and irregular.

Case II. Male, Mexican, aged twenty. Born and reared in the interior of Mexico.

Face badly pitted from variola. So young when he had variola that he does not remember it. Has characteristic shortening of right forearm with ulna extending beyond the radius so as to deflect the hand to the radial side. The arm, while limited in supination and pronation, is sufficiently strong to permit ordinary manual labor. No external evidence of suppuration.

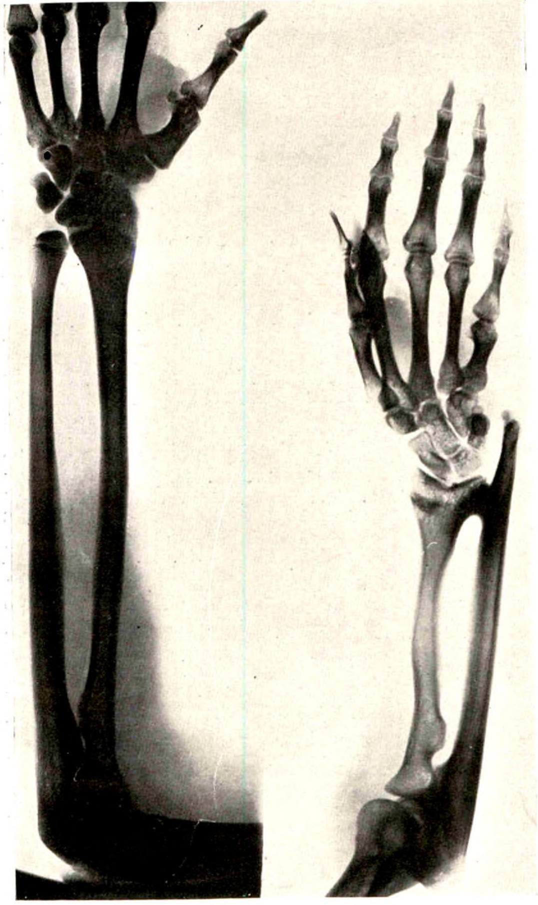

FIG. 2. Case II.

Roentgen Report. Left forearm: Ulna extends 3 cm. beyond distal head of radius deflecting hand sharply to the radial side. The distal head of the ulna is cone-shaped with partial absence of the articular surface.

Radius: The shaft of the ulna has fused to the distal head of the radius forming a firm bony union. There is increased density with roughened borders at the distal epiphysis suggestive of old inflammatory changes. The proximal ends of the radius and ulna are negative.

Comparison of length of right and left forearms:

Left radius 27 cm. Right radius 15 cm.
Left ulna 29 cm. Right ulna 22 cm.

CONCLUSIONS

In variola necrotic foci are scattered throughout the osseous system, and when the disease is sufficiently extensive, ossific centers in developing bone may be destroyed and the growth of the bone inhibited, producing marked deformities.

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DISCUSSION

DR. D. B. PHEMISTER, Chicago. Drs. Brown and Cathcart sent me a roentgenogram of their first case before I knew of Musgrave's work. I was inclined to consider the condition one of multiple osteomyelitis of the metaphyseal regions due to pyogenic organisms entering through the skin eruption. However, the fact that six lesions had resulted in destruction of the epiphyseal cartilage and arrested longitudinal growth of shafts was strongly against this view. Since learning of Musgrave's observations in the Philippines, I believe that the lesion must be the result of the smallpox virus. The bone marrow lesions described by Mallory are small and multiple and it is surprising that a small lesion should destroy the epiphyseal line when it escapes so frequently in very extensive pyogenic osteomyelitis. Further work on the bones of children dying of smallpox will be necessary in order to clear up the exact nature of the pathology.

TELEOROENTGENOGRAPHY AS AN AID IN ORTHOPEDIC MEASUREMENTS*

BY PRESTON M. HICKEY, M.D.

ANN ARBOR, MICHIGAN

THE writer has been impressed with the difficulty of making accurate measurements of the length of the limbs in orthopedic work. The inherent difficulty of accurately recognizing the anatomic landmarks so that they can be used for methods of measurement has always been an obstacle in the accurate measurements of the femur, tibia, and other bones. It occurred to the writer that by the use of teleoroentgenography the shadows cast upon the roentgen plate by the long bones might be used as an accurate means of measurement. Accordingly, at first, two 14 × 17 cassettes were placed end to end, the patient placed upon the floor with the cassettes underneath the parts to be measured, and the exposures made with a tube film distance of 7 ft. The results obtained this way were sufficiently encouraging to warrant the working out of a more precise technique. In placing two 14 × 17 cassettes end to end there was naturally a gap between the films due to the presence of the metallic edge of the film holders. At first a long strip of lead was placed alongside the patient's limbs, and this lead shadow was used in the accurate matching of the films. As this was cumbersome, one of the cassette manufacturers very kindly made a long cassette which was fitted with two sets of 14 × 17 intensifying screens accurately matched and placed end to end. This gave a total film length of 34 in. and a width of 14 in. In trying out this method it was found that the error which would occur from distortion was so slight as to be negligible.

The procedure, therefore, is to place the special cassette containing the films upon the floor, extend the patient carefully upon the cassette and raise the tube to the limit of the tube stand. In the observations that have been made, the tube film distance has been about 7 ft.

An interesting feature of these examinations is that by the use of teleoroentgenography, the blurring due to scattered radiation has been minimized so that satisfactory exposures have been made through the thicker parts of the body, where we are now accustomed to use the Potter-Bucky diaphragm. The exposure necessarily is lengthened, but owing to the fact that these measurements have been made only in parts which are not moved by respiration, the lengthening of the exposure does not inconvenience the patient. Inasmuch as the quantity of radiation diminishes with the square of the distance, the long exposures do not entail any more risk of a dermatitis than if the exposures were made in a shorter time with a shorter tube film distance.

This method has been tried out in coöperation with the Bone and Joint Department of the University of Michigan Hospital, and has been found to be a very useful procedure in making accurate measurements of the lower limbs in normal and pathologic bone conditions. It has been found most useful in the measurements of the femur and tibia in cases of congenital dislocation of the hip, and also in cases of a hypoplasia due to the late results of anterior poliomyelitis, tuberculosis of the hip, etc. It is also an accurate method in measurements of cases where shortening is suspected following fracture.

The writer submits this method of more accurate measurements with the idea that, while it probably will not be adopted as a routine procedure, it will be found useful in selected cases where the surgeon may wish to have an accurate measurement of the length of the bone, especially in cases which he wishes to keep under observation for a considerable length of time.

DISCUSSION

DR. PHILIP LEWIN, Chicago. There is one point about teleoroentgenography that I think is very important. That is, in a case with one short leg, difference in height of posterosuperior iliac spine dimples, with a curvature of the spine, where in order to level up the pelvis, the surgeon is going to remove a piece of bone from the femur of the opposite side. The inaccuracy of these measurements is well known when they are made from the anterosuperior iliac spine down to the lower border of the internal malleolus, but I think here is a method that tells you accurately how much of the femur you should take out, if you are going to take out any, in order to level up the pelvis in these cases of inequality of length of legs with curvature of the spine.

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*Read at the Twenty-fourth Annual meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

I would refer you to an article in the *Journal of the American Medical Association*, March 18, 1922, in which I discussed the subject of leveling the pelvis in cases of inequality of the length of the legs.

ROENTGENOLOGICAL EVIDENCE OF APPARENTLY HEALED MILIARY TUBERCULOSIS OF THE LUNGS*

BY EDWARD S. BLAINE, M.D.

CHICAGO, ILLINOIS

IT has been the experience of a few roentgenologists to encounter occasionally an unusually rare and startling film of the thorax in which numerous shot-like shadows are evenly distributed over both pulmonary fields. The significance of these shadows is of great interest to those engaged in the roentgen method of medical diagnosis, and is the basis of this presentation. I have encountered several such cases, three of which are detailed herewith, in which the roentgenographic findings were quite similar.

The major roentgen-ray findings consist of the presence of multiple, disseminated shadows of rounded outline and marked degree of density, having sharply bordered edges, all of which are very small in size (not over 3 mm. in diameter at most). These shadows are spread evenly all over both lung fields, no portion being free and no part containing more than another area. The areas between these small, hard shadows present normal roentgen-ray transparencies. The degree of shadow density is that found in local calcification of soft tissue structure such as is often seen in or near the lung root areas in many healthy adult individuals. The individual shadows are distinctly discrete and well separated from each other, no coalescing or merging being present. In none of the three cases observed is there any degree of fibrosis of the lung.

To one familiar with the roentgen-ray shadow appearance of acute miliary tuberculosis, the similarity of distribution of the abnormal shadows with those the subject of this study, is striking. In the acute form the shadows are more numerous, are smaller in size, soft and hazy in outline, and lie very close to each other; all of which results in a mottled appearance of the lung fields. The individual shadows of acute miliary tuberculosis lack both the degree of density and the sharply bordered edges of the healed calcified tubercle.

Having in mind the morphology of the active as well as the inactive or healed tubercle, one can find a rationale in explanation of the particular roentgen findings in question. Obviously, these shadows individually do not represent the beginning of a single tubercle, inasmuch as this is of microscopic size. When fully developed, however, it reaches the size of a millet seed (from which the term "miliary" is taken) which measures from 2 to 3 mm. in greatest diameter. This is of sufficient size to be projected on the roentgen-ray film, the resultant shadow area being larger than the lesion itself, provided the tubercle has undergone degenerative changes in which an increase of tissue density occurs—as for example, calcification. Even small areas of caseation necrosis, when surrounded by normal aerated lung tissue providing a marked contrast of density, will cast roentgen ray shadows which, though small, can be visualized. It is well known that every roentgen-ray shadow, regardless of what structure it represents, is an enlargement of the size of that structure, and this assists in projecting the unit lesion of tuberculosis, provided it has undergone the tissue changes already referred to.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

The pathologist (Schmauss-Ewing) informs us that "in tissues entirely fibrous and scar-like or calcified, no living bacilli are found, and inoculations of animals with such material remain negative, while from caseous foci, infection is always possible. Hence, tuberculosis is curable, and at times heals spontaneously. The remains of tuberculous collections in the lungs are frequently accidentally found at autopsies after death from other causes."

Osler and McCrae tell us that "the spontaneous healing of local tuberculosis is an everyday affair. A majority of those infected never have the disease, *i.e.*, they recover without symptoms, without the slight lesion having disturbed the health. Many cases of adenitis and disease of the bone or of the joints terminate favorably. The healing of pulmonary tuberculosis is shown clinically by the recovery of patients in whose sputum elastic tissue and bacilli have been found; anatomically, by the presence of lesions in all stages of repair. In the granulation products and associated pneumonia a scar tissue is formed, while the smaller caseous areas become impregnated with lime salts. To such conditions alone should the term 'healing' be applied."

Dunham reports that he has found on section of a large calcified node, a center of caseated material from which he recovered and demonstrated living tubercle bacilli.

Spengler describes the results of a necropsy on a case of healed miliary tuberculosis which closely fits with the roentgen ray appearances under consideration here, with the exception that he did not find the healed tubercle to be calcified. More recently Lorey reports a similar case, although the feature of calcification was not present inasmuch as the entire lung fields cleared completely after a few months, the first plates showing the same distribution as those under consideration here.

H. Gideon Wells, in a personal communication, writes: "I have no doubt whatever that miliary tuberculosis may heal. In fact, I suspect this happens frequently. Miliary tuberculosis ordinarily kills only by producing a meningitis. I see no reason why one might not have quite an extensive miliary tuberculosis without meningeal involvement, in which case there is no obvious reason why it may not heal, but if it does heal no one would ever know it, for miliary lesions may heal with no recognizable scars by which the healed condition might be detected. A calcified tubercle, even, cannot be positively identified as a tuberculous lesion, however certain one may be that it is such. For example, we often find the spleen studded with minute calcified globules, the origin or nature of which cannot possibly be determined."

Miliary tuberculosis results from a spread or dissemination of a primary focus, from which organisms gain entrance to a vein, which in turn is the means of carrying the escaped tubercle bacilli into many of the body organs. In the event that the primary focus breaks down and showers the bacilli into an artery, the disease will be limited to the area of tissue supplied by that vessel, and thus the involvement may include an entire organ or only a small portion of it. Therefore, it is possible to have the entire lung invaded by the bacilli, the showering being equal in all portions; or a small part of the lung, as for instance, one lobe, or even part of a lobe, may be involved. The resulting miliary tubercles pass through the usual changes characteristic of this lesion and the patient usually succumbs in a short time from the overwhelming attack, particularly when of the venous transportation form, when it invades the meninges.

The individual tubercles in this type of lesion remain as single areas of pathology and do not merge or coalesce as they do in the fibrous and caseous forms in which many small tubercles fuse and spread out into the surrounding tissues, thus becoming large areas of degeneration, at times invading an entire lobe. The appearance of caseation necrosis is fairly rapid in a tubercle due to the toxic products of the tubercle bacilli and to the complete absence of blood vessels through the lack of which it receives no nourishment. The calcification of the tubercle is an end stage of the process and the calcified tubercle is no longer potent as a retarding factor in the well-being of the individual. In fact, it is similar to the clinker of burnt-out coal of the furnace fire, no longer capable of further activity. Thus, one may properly assume a healing, as it were, of those particular foci that are seen, on the roentgen-ray projection, to be calcified.

Occasionally an individual attack by such a shower of tubercle bacilli may, by some peculiarly favorable turn of events, become sufficiently resistive to overcome the barrage: the numerous caseous tubercles undergo a recession, and a healing takes place in which such changes as dense fibrosis—which may become massive in extent—or perhaps calcification, occurs. That this latter sequence occurs (though evidently at rare intervals) is evident from the developments in such cases as are here presented.

In a majority of instances, the paucity of clinical symptoms is surprising. In the phlegmatic individual it is difficult to elicit any history of an acute sickness in the ordinary sense. He is prone to overlook or underestimate the importance of a period in which he did not feel well, his appetite was not up to normal, or he seemed to lack his usual "pep" for a few days or a week or two, and he may have paid no attention to such a physical falling off. Following this uncertain period, he recovers his former more or less normal condition. On the other hand, the high-strung or neurotic type of person most often recalls such a period in which he had to lie down or go to bed for a few days, later getting along all right, often without recourse to the physician. In such cases one is less reluctant to believe that an acute miliary tuberculosis is a possibility. A rise in temperature may not be recognized by the former group, who often have an increase of two or more degrees without realizing it, while the latter invariably know that they have fever. Headache, malaise and the usual accompaniments of temperature increase are a part of the story of the more highly strung person, while the phlegmatic individual invariably fails to note such occurrences.

That an active tuberculosis can be present in the intervening areas is not to be denied, but when these areas which lie between the individual dense shadows under discussion are of normal transparency to the roentgen ray, it is safe to assume this particular tissue to be normal, especially if there be no clinical evidence of a pulmonary disease at the time of the roentgen examination. This situation is one of the chief points of my observation, and is definitely established before the case is regarded as one of healed miliary tuberculosis.

A varying number of these lesions are present in the different cases; in one we find the multiple spots lying so close together that there is little of the lung field that can be visualized, literally thousands of foci being evident; in another case, the foci are so far apart as to throw some doubt on the point of its being properly considered a disseminated miliary tuberculosis. One will recall that the term "miliary" usually refers to the size of the tubercle, and one may have but a very few of such miliary tubercles or, on the other extreme, so many as to startle the observer when he views the case roentgenologically. Here enters the probability of an involution of the majority of the tubercles, a few only undergoing calcification. The individual lesion, however, is in both instances, substantially the same. While it is true that the calcified tubercle is not in itself a positive sign of a preceding active tuberculosis, the greater incidence makes the probability so great as to permit us to assume such to be the case.

Case I. Male, white, aged thirty-six, 5 ft. 7 in. in height, and weighs 145 lbs. He does not look sick, and his general makeup is that of a robust phlegmatic individual. He complains of a moderate cough and raises a small amount of sputum which often shows red streaks. He gives a history of a pulmonary hemorrhage which occurred several years ago, but this was not accompanied by any other symptoms that he noticed. No investigation of the sputum was made at that time. Repeated examinations of recent sputa fail to show any tubercle bacilli. No rise in temperature was noted, but this is the patient's opinion only, no thermometer being used. His weight has been more or less stationary as far as he knows, but he says he has weighed more and, at times, less than at present. He works out in the open. He appears to be well built and well nourished. Roentgen examination results in the extraordinary finding seen in Figure 1, in which disseminated, multiple, small, dense shadows are evenly distributed in all parts of the lung fields. Viewed stereoscopically, these shadows represent calcified foci in the pulmonary tissues. When an explanation of these most unusual shadows was sought, the patient was found to have worked for a brief period (three weeks) laying a cement sidewalk. This is the single instance in which he was so occupied, and he never worked in an atmosphere in which he had to inhale quantities of dust of any kind. A silicosis can also be ruled out, inasmuch as he has never been occupied where such material was used. It was thought by one observer interested in the case that the numerous densities represented an inhalation lesion or calcicosis, but this does not seem to be tenable because of the relatively short period of employment (out in the open) as a cement worker. It is highly probable that these unusual shadows represent the sequence of a sudden increase of body resistance to a showering of tubercle bacilli which gained entrance in the arterial trunks supplying the lungs from a broken-down tubercle lying somewhere close to the lumen or in the wall of such a vessel. It is, of course, possible that the patient had a more extensive dissemination, that is, in other organs, pleura, etc., but obviously this cannot be determined by the roentgen examination; it is seen only in the lung because of the favorable contrast of tissue densities which permit the visualization of these very small calcified masses.

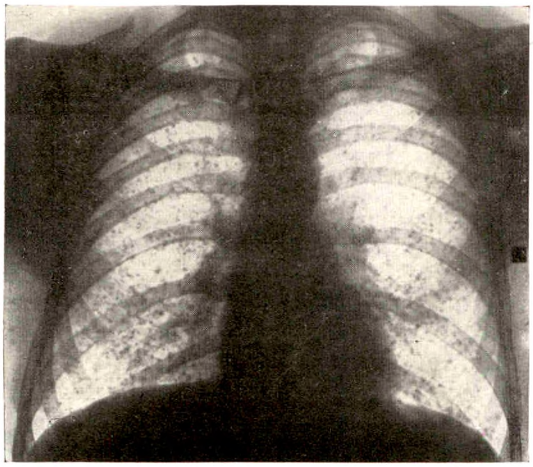

FIG. 1.

CASE II. Male, aged thirty-four, 5 ft. 7½ in. tall, and weighs 115 lbs. He is an automobile mechanic. His complaint sounds more or less like a textbook recitation of the symptoms of pulmonary tuberculosis, but the outward evidences which would confirm his story are not present. He reports a loss of 45 lbs. since 1918. The clinical findings did not indicate a pulmonary disease, being practically negative in auscultation, palpation, sputum, etc. This, however, does not tell us what he may have had in the way of sickness prior to the present time. He says that he has been diagnosed clinically as "tuberculosis." The roentgen findings are as seen in Figure 2, the most striking feature being a dissemination of small, hard-looking, sharply bordered shadows that represent calcified foci in the lung, which are the healed areas of previously caseated tubercles of miliary size. These spots do not lie as close to each other as those found in Case I. This brings up the question of whether a large number of the tubercles in the intervening areas did not undergo a calcification necrosis, as might have been the course in Lorey's case, but did involute and were later absorbed.

CASE III. Male, white, aged twenty-four, single, laborer. He has been up and down in weight, averaging 165 lbs. He is well developed, well nourished, and did not appear to be acutely ill at the time of roentgen examination. He complains of pains in chest as well as in stomach. In May, 1922, he had four hemorrhages from the lungs, occurring at very short intervals, during which he lost a large amount of blood. He had seen a doctor just previous to the occurrence of these hemorrhages, and a temperature of 102° was found. He was instructed to go to bed, but remained around home and did not go to the hospital or seek further medical advice. He states that in January, 1922, he commenced to have pains in his left chest around the heart, and thought it was heart trouble. In August he complained of some shortness of breath, and was admitted to the hospital, where he was treated for "lung trouble." Microscopic studies revealed repeated positive t.b. sputum. He has had no positive sputum recently. The roentgen findings are as illustrated in Figure 3, which shows a number of small calcified areas fairly evenly distributed throughout both lung fields. Here again we see the millet-seed-size shadow densities similar to those noted in the preceding cases, though more widely separated, which one has reason to believe represent healed calcified tubercles.

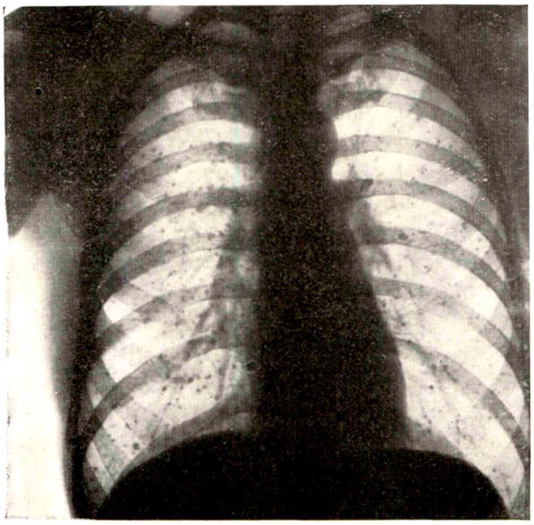

Fig. 2.

SUMMARY

1. From post-mortem studies reported in the literature, it is evident that at rare intervals a miliary tuberculosis of the lungs will heal. Occasionally this healing seems to be accompanied by a calcification necrosis of the individual tubercles, which calcification remains as sole evidence of the disease.

2. The roentgen findings in such cases are numerous small, shot-like shadows, evenly distributed over both pulmonary fields.

3. The distribution of lesions is characteristic of disseminated tuberculosis of miliary type.

4. Although lacking post-mortem proof, it is highly probably that the 3 cases here reported are to be considered as instances of healed, calcified miliary tuberculosis of the lungs.

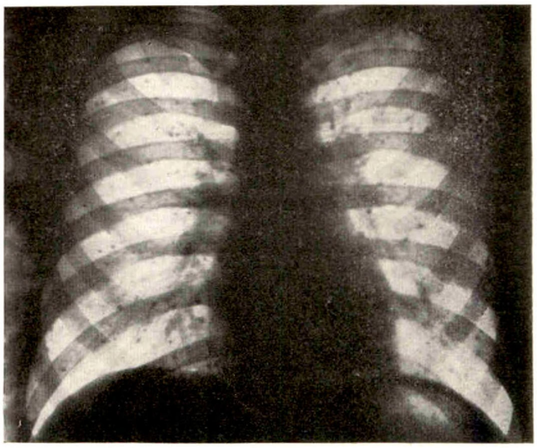

Fig. 3.

ABSTRACT OF DISCUSSION

Dr. Blaine's paper was freely discussed. The consensus of opinion was that there is no proof that these lung findings represent healed miliary tuberculosis, but that after all this seems the most reasonable explanation. Several of the members reported cases with roentgen findings closely resembling those seen in Dr. Blaine's cases. Dr. Pendergrass suggested the possibility that the miliary shadows are due to calcium metastasis in the lung and Dr. Martin reported a case in which they were interpreted as calcified areas due to healed trichinosis.

THE VALUE OF THE ROENTGEN RAY IN THE DIAGNOSIS OF ATYPICAL PREGNANCIES, WITH REPORT OF TWO CASES OF ANENCEPHALY DIAGNOSED BEFORE BIRTH*

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THE diagnosis of or confirmation of diagnosis of pregnancy by the roentgenogram is not new. Since 1899, when Mullerheim reported his work, there have been sporadic reports of roentgenographic work done on pregnant patients. Bartholomew places so much dependence on the roentgenogram that he makes it his fourth positive sign of pregnancy. In spite of this, there is still, throughout our very conservative profession, one of whose most conservative members is the obstetrician, a marked hesitancy to submit the pregnant woman to any roentgenographic procedure because of a supposed danger to the fetus. This is a fallacious attitude and is unjustifiable in view of our present technique and experience. From a medicolegal standpoint the roentgenogram is unanswerable in a case of doubtful pregnancy after the fifth month of gestation. Orndoff reports its value along these lines in a private conversation, and Stein and Arens[1] describe a situation which could easily be of legal significance.

With all due respect to the ability of the obstetrician to make and interpret properly the various pelvic measurements, I believe that the addition of good stereoscopic roentgenograms will give him a much better understanding of the relation of the pelvic structures than will measurements alone. This is especially true in cases of contracted pelves and of spinal curvature. Here are shown not only the details of the bony deformities, their relation to each other, possible compensations, etc., but also the actual relative size of the fetal head which must pass through this outlet.

Multiple pregnancies are sometimes diagnosed—frequently only suspected—and often have been completely overlooked before labor. The usual suspicion is an hydramnios with a single pregnancy. One of my cases referred as hydramnios, which was present, showed an unsuspected twin pregnancy. It is of rather vital importance to know the position of the fetal parts, especially the heads, in these multiple pregnancies, to offset troubles at delivery. The life of one of the babies may have to be sacrificed if there arises a condition of locking of the heads, etc., which occurs frequently enough to justify several pages in all books on obstetrics. Forewarned is forearmed; hence the value of the roentgenogram. In marked toxemia of pregnancy, a roentgenogram will be of extreme value even in the negative sense—that is, to show that the fetus is apparently normal; but its greatest value will be to point out abnormalities and thus allow the obstetrician to terminate a dangerous situation. One of my cases of anencephaly was sent in to determine whether to fight the toxemia or to terminate the pregnancy.

A roentgenogram should always be taken in a case where Cesarean section is contemplated because of fetal or maternal dystrophies or disproportions—emergency operations in eclampsia alone being excepted—and it is advisable here if time permits. The roentgenographic procedures require a comparatively short time. The embarrassment of delivery by Cesarean section of a monster, an already dead fetus or an extremely small child might be prevented.

The size of the fetus can be fairly accurately determined by the roentgenogram and an approximation of the age can be reached. In spite of the excellent work of Hess, I feel that we are not yet in a position to state the exact age of the fetus in utero; there are too many of the finer details of the osseous structure lost or blurred by distance from the film, movement and that multitude of details which constantly arise. The position and change of position of the fetus can be determined accurately. I have seen a breech presentation at the eighth month become a cephalic presentation two weeks later. A foot or transverse presentation can be shown with certainty and if a version is contemplated, the probable modus operandi can be determined before labor. Spalding[2] has given to the profession one of the very few pathognomonic signs of intrauterine fetal death, the overlapping of the cranial bones before labor. Two of my cases have given the impression of a shrinkage of the cranial contents with a flattening of the normal transparietal arch or dome without definite overlapping of the bones, a sort of flattening of the head; a condition which I believe precedes the overlapping of the bones. Death of the fetus had been suspected only a few days in these cases and I am confident that *later* roentgenograms would have shown the overlapping. These patients were delivered of dead fetuses.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

Case,[3] in 1917, reports the first and only case of anencephaly roentgenologically diagnosed that I have been able to find in a review of the literature at my disposal. He says: "A careful search of the literature has failed to disclose the report of a similar instance." The pathologist's report and the roentgen-ray findings in my cases correspond in almost every detail with the case reported by him.

Anencephaly, or better craniorrhachischisis, is one of the most frequent of all fetal monstrosities. Kirkness in 1911, reported one case of anencephaly in every 900 deliveries in a series of 11,521 births in the Rotunda Hospital. Of the several theories of the etiology of this condition three seem to have most support: (1) Early hydrocephalus of the fetus with rupture and later atrophy of the cranial membranes (Ahlfeld as quoted by Carey)[4]; (2) Changes or toxis in the amniotic fluid (Webber-Hertwig); (3) Faulty implantation of the ovum due to changes in the endometrium (Mall-White).[5] I will not enter into a discussion of these theories, nor will I theorize on the other abnormalities which I am convinced can be as easily shown on the roentgenogram.

It has been my privilege to see 2 unsuspected cases of this abnormality and to make a correct diagnosis before delivery—in fact, to have the pregnancies terminated to spare the mother the many trials of continuing pregnancy and the chagrin of delivering a monster at term.

CASE I. Female, white, aged twenty-one, seen Oct. 10, 1921, having been married seven months. Family history negative. Menses began at fourteen, always irregular and painful; last menstruation May 5. Some nausea for four months. Movements felt Oct. 10. Examination shows uterus of about size of four months' pregnancy. Blood pressure 118 over 80; Wassermann negative; general condition excellent. Patient was seen each month, nothing abnormal being noticed until Jan. 10, when there was marked hydramnios. The presenting part could not be determined. Jan. 14, patient referred to Roentgen-ray Department to determine if possible the cause of hydramnios and to ascertain the presenting part. Roentgen-ray report Feb. 6: Film shows no fetal cranial bones, vertebrae poorly developed, length of spinal column less than normal, ribs demonstrable with bones of face close to thorax; bones of extremities appear normal. Roentgen-ray findings indicate an anencephaly. Feb. 14, patient states she has felt no movements for four days. A second roentgen examination shows no change from previous report. Feb. 18, labor induced. Fetus delivered normally, weight 5 lbs. Pathologist's report:

"The specimen consists of a female fetus, 33 5/10 cm. long. The surface reddened everywhere, and the superficial layers of epithelium partially desquamated. The head is imperfectly formed. It begins to slope backward immediately above the eyes and from the upper borders of the ears. Just a fringe around the periphery is hair-covered. The remaining surface is red and smooth except for an irregular mass about 3.5 cm. in diameter which lies just above the widely open vertebral processes. The vertebrae have failed to close for a distance of 10 cm. from the highest point of the head. This is approximately half the total length of the vertebral column.

Pathological Diagnosis: Craniorrhachischisis of fetus of late seventh month."

CASE II. Female, married, first seen July 8, 1922, aged twenty-eight. Family and personal history negative; miscarriage at two and one-half months in 1921; no other pregnancy until present one. Last menses May 7, 1922. Quickening Oct. 5th; expected confinement Feb. 14, 1923. Physical condition good excepting pyorrhea. Blood pressure 110 over 80. Progressed all right until Dec. 14, when albumen and casts appeared in urine; blood pressure 140 over 110. From this time until delivery, in spite of most careful attention, blood pressure remained high and urine continued to show albumen and casts. At eighth month the uterus was not so large as it should have been. Because of this and the toxemia patient was referred to the Roentgen-ray Department. Roentgen-ray report Jan. 19, 1923: Films show anencephaly with marked shortening of the vertebral column, small thorax, rather large femurs and tibiae. Delivered Jan. 20, still-born; non-instrumental labor. True "frog fetus"; almost identical with description of previous case.

SUMMARY AND CONCLUSIONS

1. Roentgenograms of pregnant uterus are apparently without danger to either fetus or mother.

2. Roentgenograms should be made before finally determining on Cesarean section.

3. Roentgenograms are of distinct value in medicolegal situations.

4. Every pregnant woman showing anything abnormal should have roentgenograms made. They give valuable information even though it be in the negative sense.

5. Fetal abnormalities can be more accurately determined by roentgenograms than by any other method.

Note: I wish to express my sincere thanks to Drs. Bourland, Gordon and Carr of the Medical and Surgical Clinic for their cooperation in this work, and for their permission to report these cases.

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STATISTICS AND TECHNIQUE IN THE TREATMENT OF SUPERFICIAL MALIGNANCY WITH RADIUM, ROENTGEN RAYS AND ELECTROTHERMIC COAGULATION*

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I BELIEVE that every case of localized malignancy of the skin will recover if treated thoroughly and skilfully with radium, roentgen rays, and electrothermic coagulation. Also many of the cases that are just beginning to show metastasis into the immediate neighborhood can be cured by similar treatment. The results of treatment in cases showing definite any combination of the above physical agents. Squamous-cell epitheliomata must be treated early with thoroughness and skill because of their rapid growth with metastasis. One must irradiate thoroughly the actually diseased area together with all the lymphatic chains draining it. If efficiently treated before there is metastasis, fibrosarcomata can be cured. Here too

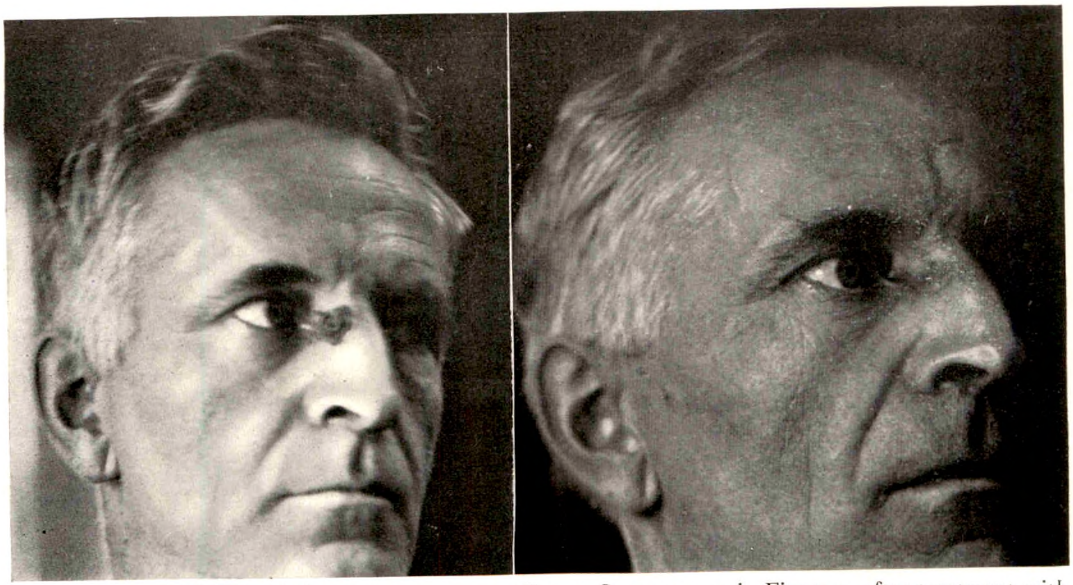

FIG. 1. Epithelioma before treatment.

FIG. 2. Same case as in Figure 1, after treatment with electrothermic coagulation and radiation.

metastasis often at considerable distances from the primary lesions, together with those known as hopeless from every standpoint of the older method of treatment while most encouraging from the palliative standpoint, will not be productive of many permanent cures.

Pathologically, malignancy of the skin is classified under three great groups: (1) Basal cell epitheliomata, (2) squamous-cell epitheliomata, and (3) sarcomata of the fibroid and melanotic types. Basal-cell epitheliomata are easily eradicated with the lymphatics and blood-vessels draining the diseased area should be closed with radiation treatment. Owing to the extreme malignancy of melanotic sarcomata, with their rapid growth and early systemic metastasis, treatment is seldom followed by more than slight palliation. The time to treat this disease is before it becomes sarcomatous, i.e., the melanomata. I have treated a number of these melanomata and to date have had no recurrences or deaths from melanotic sarcomata following such treatment. Therefore, I cannot too strongly advocate the removal of the premelanotic sarcomatous lesions, the melanomata, particularly if they are located upon parts subject to constant irritation, or if they are prone to develop ugly symptoms such as sudden, rapid growth, bleeding upon slight injury, sticking to clothing, scaling, etc.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

Generally I treat these skin malignancies first with a complete destruction of the lesion by means of electrothermic coagulation. This is a surgical procedure and consists of the use of the high-frequency current passed through the tissues with sufficient intensity to coagulate them. The coagulation is due to the generation of heat within the tissue itself while the applicator remains cold at all times. For the smaller lesions the Ouidin current is used, while the larger and more extensive lesions require the d'Arsonval current. If the latter is used, a large pad or metal electrode is connected with one pole of the machine, the pad being placed usually under the buttocks of the patient. To the other side of the machine the destructive electrode which is usually a point, is connected. The point is then held in contact with the tissue to be destroyed and the current is turned on. The amount of current necessary must be learned by actual experience since the milliammeter is not a reliable guide. The coagulation at one point is completed when the tissue is dead white and the current should be switched off just before sparking begins. The coagulation should begin in the healthy tissue well beyond the edge of the actually diseased area. This produces an obliteration of the blood and lymph channels which tends to prevent metastasis. After this coagulation wall has surrounded the lesion completely, the diseased tissue itself is destroyed and can then be removed with a curette or scissors, the operator being most careful that he does not get into parts beyond the coagulated tissues.

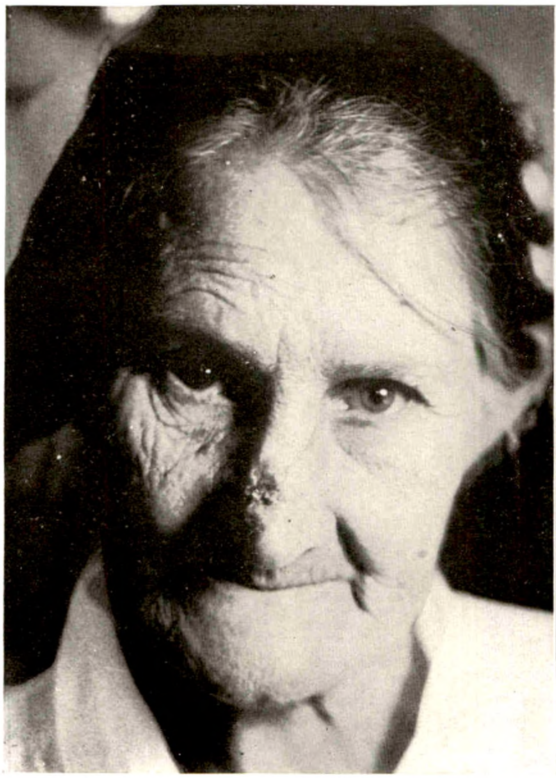

FIG. 3. Epithelioma with deep destruction before treatment.

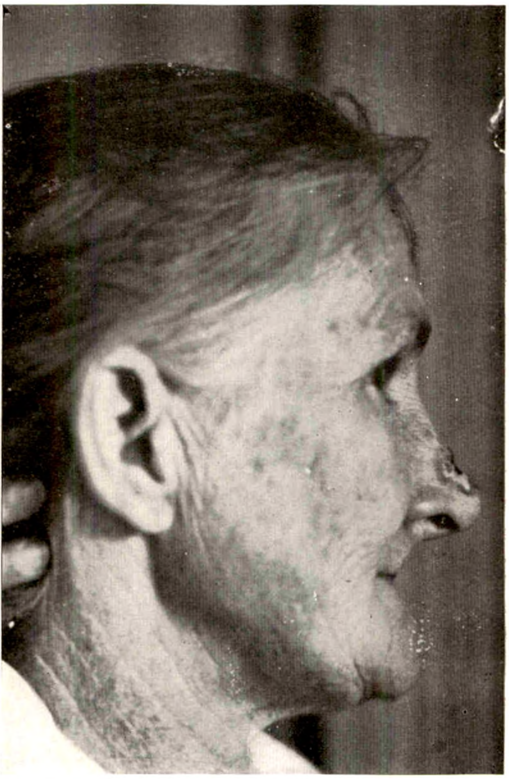

FIG. 4. Same case as in Figure 3, side view.

Basal-cell epitheliomata are irradiated immediately following coagulation with the roentgen rays. The radiation field is so mapped out that the rays extend well beyond the edges of diseased tissue into the healthy tissues. The factors for treatment are: 4 ma. 134,000 volts; 6 mm. Al. filter or 0.25 mm. Cu. plus 2 mm. Al.; 8 in., 12 in., 16 in. and 20 in. focal distances are used; 170 electrostatic units dosage. An electrostatic unit is a quantity of electricity sufficient to raise a sphere of a radius of 1 cm. to the unit of potential, i.e., 300 volts. One electrostatic unit of radiation is a quantity of radiation sufficient to ionize each cubic centimeter of air in the radiation beam so that it will allow the passage of one electrostatic unit of current. One electrostatic unit of current equals one electrostatic unit of charge per second. The number of electrostatic units of current multiplied by the number of seconds equals the number of electrostatic units of charge in the period of time. Filtration and focus-skin distances are varied as already described, the lighter filtration and shorter focus-skin distances being used for the most superficial cases, the heavier filtration and longer focal distances being used for cases with deep tissue involvement.

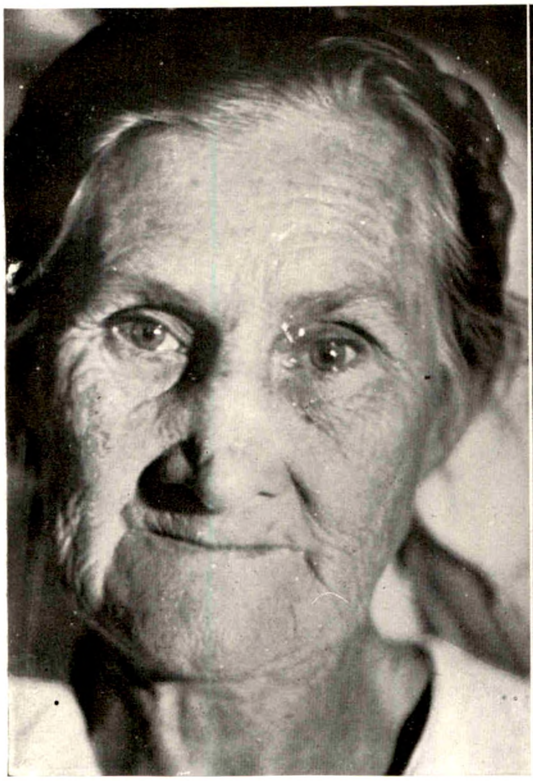

Fig. 5. Same case as in Figure 3, after treatment with electrothermic coagulation and radiation.

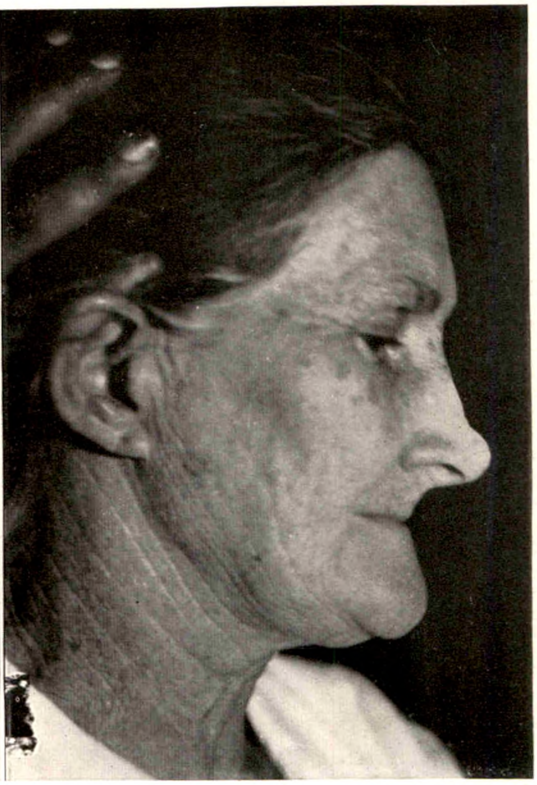

Fig. 6. Same case as in Figure 3, showing result, side view.

Immediately following coagulation, squamous-cell epitheliomata are treated similarly with the roentgen rays, using the heaviest filter and either the 16 or the 20 in. focus-skin distance already described, with 200 electrostatic units dosage. In addition, whether or not there is already involvement of lymphatics draining the diseased area, all the lymphatics are thoroughly irradiated with the roentgen rays. If the lymphatics are not involved the 0.25 Cu. plus 2 mm. Al. filter is used with the 12 or the 16 in. focus-skin distance, dosage 170 electrostatic units. If the lymphatics draining the primary site of the disease show any sign of

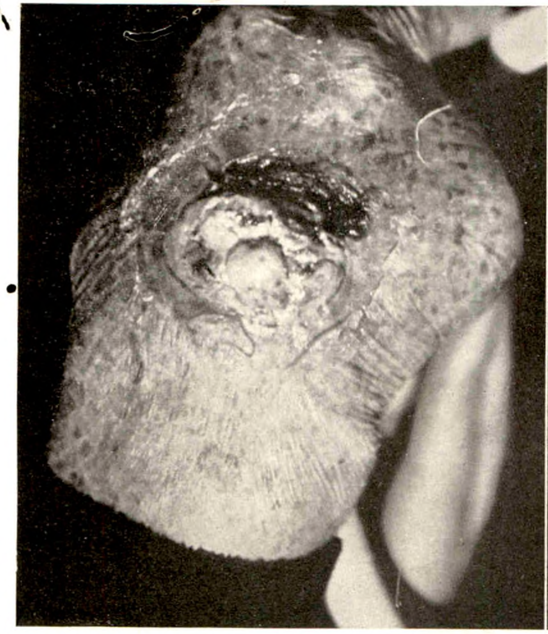

FIG. 7. Large epithelioma of dorsum of the hand.

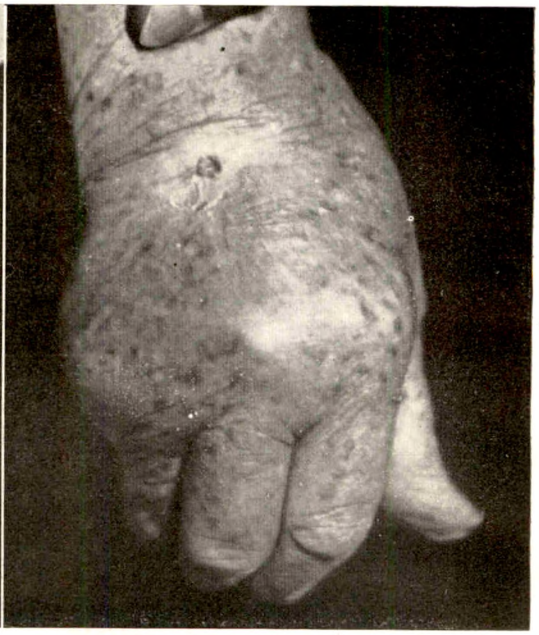

FIG. 8. Same case as in Figure 7, after treatment with electrothermic coagulation and radiation.

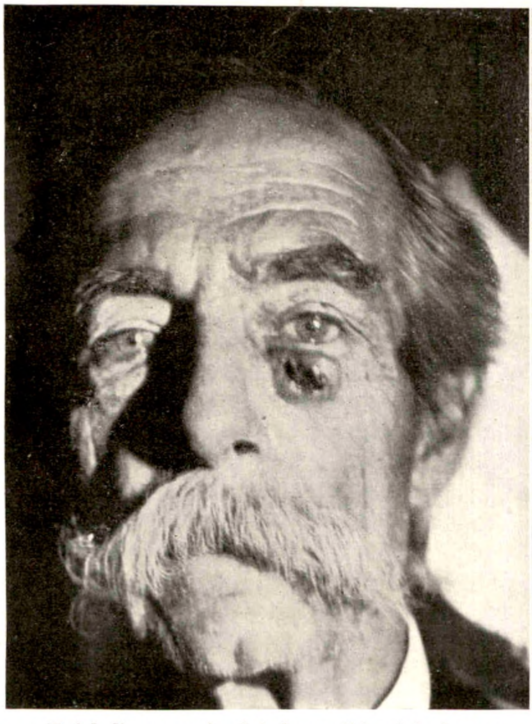

FIG. 9. Epithelioma entire left lower lid, with destruction.

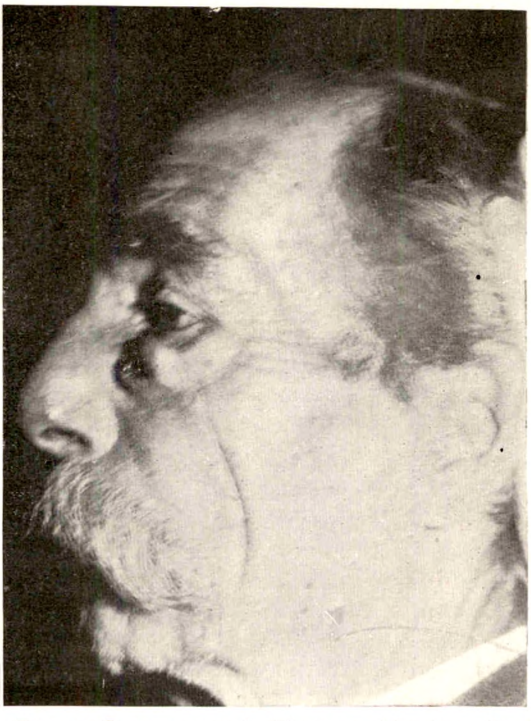

FIG. 10. Same case as in Figure 9, side view, showing depth of destruction.

involvement, they are treated thoroughly with rays produced at the maximum voltages obtainable. The factors are 4 ma.; 220,000 volts; 0.6 mm. Cu., plus 1 mm. Al., plus ¼ in. sole-leather filter; 20 in. focus-skin distance; 200 electrostatic units dosage Radium in the form of 5 or 10 mgm. needles is also added to the treatment in cases showing metastasis. The needles are buried deeply into the metastatic nodule or nodules 1 cm. apart if the 5 mgm. needles are used, 2 cm. if the 10 mgm. needles are used. They are left in place sixteen hours.

Fortunately sarcomata of the skin are much less common than is either of the above types of epitheliomata. Cases of fibrosarcomata are treated as already outlined under squamous-cell epitheliomata. I have tried many different techniques in the treatment of melanotic sarcoma, with uniform failures. As already mentioned, the time to treat melanotic sarcomata, is before the melanomata have undergone sarcomatous degeneration. Melanomata are destroyed thoroughly at one sitting by means of coagulation, which is followed by radiation, using the technique in general as described under basal-cell epitheliomata. However, particularly about the eye, it is often satisfactory to substitute a radium pack for the roentgen rays. This treatment is followed by little or no scar, and to date I have had no recurrences or sarcomatous degenerations.

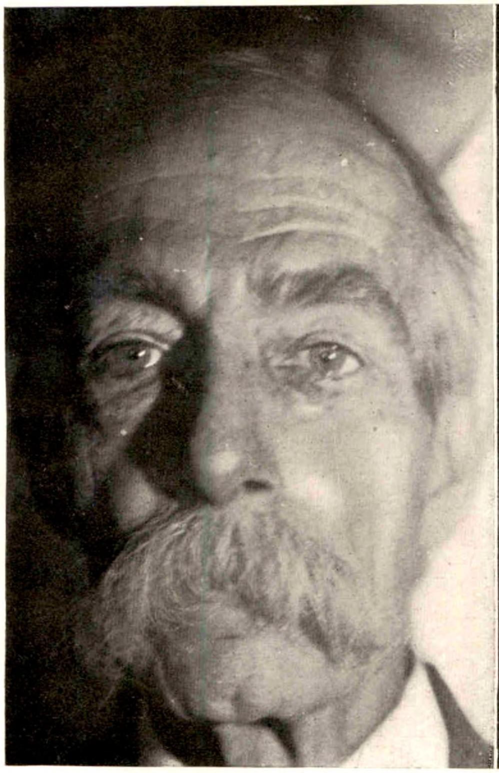
FIG. 11. Same case as in Figure 9, after treatment with electrothermic coagulation and radiation.

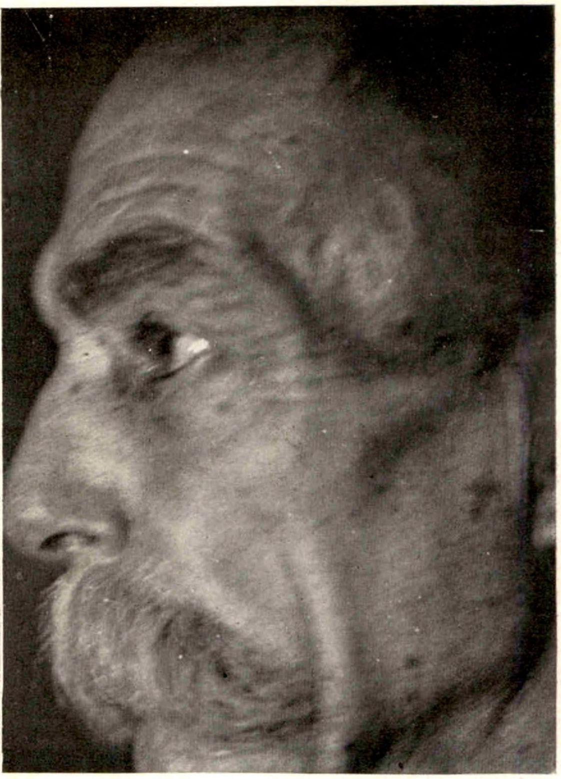
FIG. 12. Same case as in Figure 9, side view, after treatment.

In the treatment of these lesions it is of great importance that the treatment be completed as nearly as possible at one sitting. Lately I have had referred a number of cases that have had several excisions or treatments by various caustics or by repeated exposures to radium or the roentgen rays. These cases are most difficult to cure. Treatment not completed in approximately one sitting is often followed by an increase in resistance of the cells, i.e., they become equal in resistance to the normal cells, or actually have a greater resistance than the normal cells. They are called "adult cells." Therefore let us carefully learn the method of treatment of these lesions with the physical agents at our command. Particularly must we know the value of each roentgen apparatus, which is obtained by actual measurements of the radiation values with the iontoquantimeter. In no other way can the correct radiation doses be given.

BASAL-CELL EPITHELIOMATA

	No. of Cases	Clinical Cures 1–5 Yr.	Failures	Per Cent of Successes
Small	101	101	0	100
Large-deep	44	41	3	90

SQUAMOUS-CELL EPITHELIOMATA

	No. of Cases	Clinical Cures 1–5 Yr.	Failures	Per Cent of Successes
Localized	22	22	0	100
Borderline	6	5	1	83
Widespread metastasis	11	2	9	18
Recurrent	12	5	7	41

SARCOMATA

	No. of Cases	Clinical Cures 1–3 Yr.	Failures	Per Cent of Successes
Melanotic sarcomata	8	0	8	0
Fibrosarcomata (localized)	5	5	0	100
Fibrosarcomata (with metastasis)	9	0	9	0

MELANOMATA

No. of Cases	Clinical Cures	Failures	Per Cent of Successes
38	38	0	100

These 38 cases represent 87 melanomata

CONCLUSIONS

1. If treated early and correctly radiation therapy plus electrothermic coagulation can be expected to cure approximately 100 per cent of skin malignancies, with the exception of melanotic sarcomata.

2. The benign forerunner of melanotic sarcoma, the melanoma, when treated correctly with the above physical agents, should produce equally satisfactory results.

3. The results in the treatment of melanotic sarcomata are uniformly bad.

SURGICAL AND ROENTGEN TREATMENT OF CARCINOMA OF THE RECTUM*

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For more than thirty years surgery has sought, by means of a constantly improving technique, to solve the problem of the radical removal of carcinoma of the rectum. True, it has succeeded in reducing the primary mortality to a minimum; yet the statistics show only a small percentage of lasting cures. When one considers the fact that inoperable cases make up approximately 50 per cent of all carcinomata of the rectum, one sees that surgery holds out no great hope for cure of this disease. The best statistics show, after three years, a cure of only 10–12 per cent. One is therefore all the more inclined to place his hope in radiation therapy. The results obtained by Kroenig and Gauss, Seitz and Wintz, and others in the treatment of cancer of the uterus, invite an analogous conclusion as to the neighboring organ. Lamentably, this is not confirmed. The differences in situation, extent, in function of the lymphatic vessels concerned in the two cases, as well as in the sensitivity of their tumors to radiation, are too great to permit one to expect similar results. To-day we must recognize that pure radiation therapy still lags behind surgery in respect to lasting cure of carcinomata of the rectum. For one thing, radiation therapy has been limited to inoperable cases, except for such operable cases as demanded, for one reason or another, bloodless treatment. If all cases were submitted to radiation treatment only, as carcinomata of the uterus are in some clinics, we would then have a more favorable estimate of its worth. Furthermore, our radiation technique is becoming more and more satisfactory.

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* Read at the Twenty-fourth Annual Meeting of The American Roentgen Ray Society, Chicago, Ill., Sept. 18–21, 1923.

It was a natural procedure to combine the surgical and radiation methods of treatment. As a matter of fact, the results which have been published—I refer especially to the recent work on carcinoma of the rectum by my teachers Schmieden and Holfelder, by A. W. Fischer, J. Thompson Stevens, and Bowing and Anderson—indicate that this is the path to follow. *Above all, the fruitful combination of both methods of treatment demands the closest cooperation between surgeon and radiotherapist.* Before treatment is undertaken in any case, both must decide upon the best way. The operation is evaluated no longer from the purely surgical standpoint, but it must be decided in what way the operation and the radiation treatment can best supplement each other.

From this standpoint Schmieden and Fischer have adopted a method in surgery of the rectum which, while it spares the patient, has the advantage that it is radical and allows the closest cooperation with the roentgen therapeutist.

The treatment of every rectal carcinoma in our clinic begins with the formation of an artificial anus to put at rest the diseased gut, whether or not the patient suffers from manifestations of stenosis, and whether or not the case is operable. Between the navel and the symphysis the abdomen is opened so widely that the operator can easily determine the size and extent of the tumor and its metastasis in the neighborhood, and in the liver. *The principal assistant at the operation is a roentgenologist.* With his measuring instruments he determines the exact extent and situation of ~~the~~ tumor with respect to fixed points of the body, so that he can subsequently work out his radiation plan in transverse and longitudinal charts. After a method devised by Gaudier, the anal limb of the sigmoid loop is freed from its mesentery (Figs. 1 and 2) the superior hemorrhoidal artery being preserved. The sigmoid loop is then cut across at its apex. The proximal end is stitched to the abdominal wall and the anal end is invaginated and buried in the pelvis. Thus the patient is given a small abdominal anus, which, because of its short sigmoid mesentery, cannot prolapse, and which he can control better than a sacral anus.

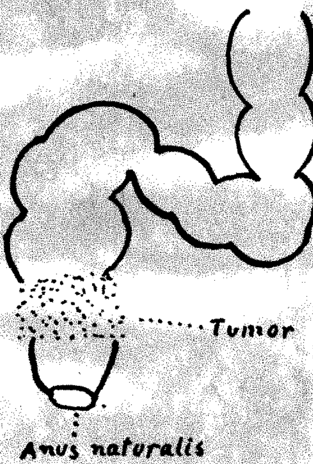

FIG. 1. Schematic drawing of the position of a carcinoma recti.

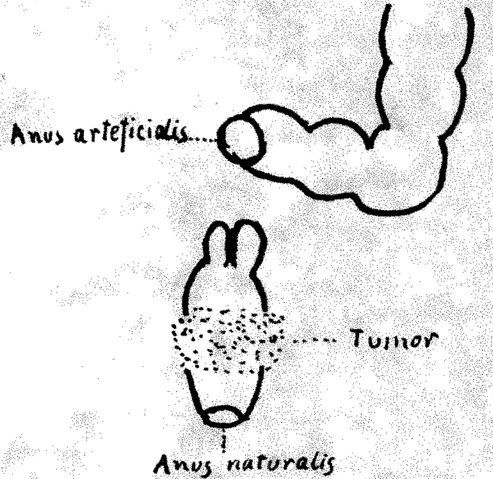

FIG. 2. The rectum is put out of use by a colostomy at the sigma.

We lay great stress upon the irrigation of the now idle portion of the gut, a procedure which is begun a few days after the operation. It brings about a decrease in the inflammatory manifestations, which, extending from the portion ulcerated by the carcinoma, make the latter appear to be of a size greater than it really is. Now, since the ulcer is spared the passage of the fecal masses which have kept it constantly irritated, and since it is cleansed by daily washing, the inflammatory manifestations subside and the tumor becomes smaller.

Some border-line cases under this treatment may come to appear operable.

Ten to fourteen days after the formation of the colostomy the carcinoma itself is attacked by roentgen treatment. Such treatment requires the same pains and care as an operation. One may speak of it as a roentgen operation. Under no circumstances may it be left to an unschooled physician, or to roentgen assistants. The most important preparation for the treatment is the formation of a *plan* of treatment. Available for this, together with the examination findings and the roentgenograms, are the topographic notes made at the operation, which outline the territory to be irradiated. The principal object is to direct the bundles of rays to the tumor and its bordering lymphatics so that a dose is delivered of such magnitude as to bring about a shrinkage of the tumor. Here our corner stone is the carcinoma dose of Seitz and Wintz and the carcinoma minimum dose of Juengling. To obtain as hard rays as possible only one of our modern high-voltage equipments is used. With the aid of the Holfelder field selector are determined the number and size of the fields, the focus-skin-distance, the direction of the central rays with respect to the body-axis, and the ray dose for all fields. We lay great emphasis upon having only the tumor and its lymphatics in the cross-fire of the rays which here unite to a homogeneous intensity. By this means we spare the sound tissue as far as possible and avoid an excess of rays acting upon the intervening blood and tissue, which could not be accomplished with the larger field method. Usually four to five fields are treated. Each of them has to have a percentile depth dose of 30–35 per cent under 10 cm. water. Two are posterior fields treated obliquely from the outer border and above, approximately in the posterior axillary line. When there is one abdominal field, it is treated in the midline, obliquely from above (Figs. 3 and 4). When there are two abdominal fields, as we use them in stout patients, they are treated in approximately the anterior axillary line obliquely from the outer border and from above. The fifth field is perineal, the patient in the lateral decubitus with legs drawn up, the rays in the body axis. This field receives only 80 per cent of the erythema dose, in deference to the sensitivity of the mucous membrane of the anus and vulva, while the other fields usually receive the full dose. To shorten the period of treatment we irradiate two sides simultaneously, if possible.

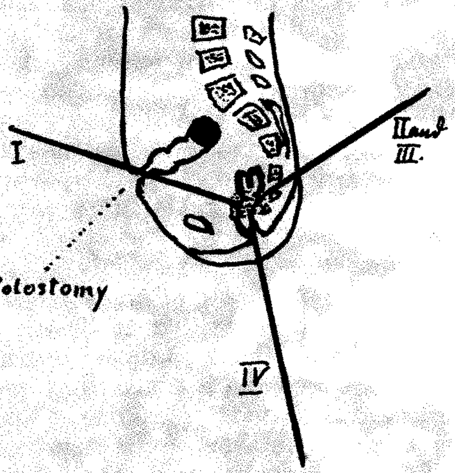

Fig. 3. Direction of the central rays in a longitudinal section. I, abdominal field. II and III, posterior fields (appear as one line, as projected at each other). IV, perineal field.

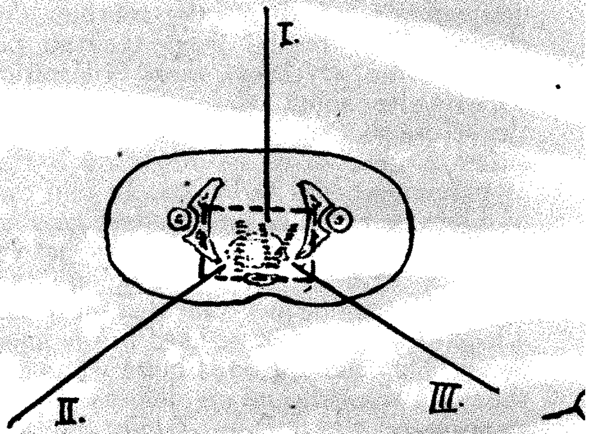

Fig. 4. Direction of the central rays in a cross section. I, abdominal field. II and III, posterior fields. The inclination to the horizontal plane of I, II, and III, as shown in Figure 3 cannot be expressed in this drawing. IV (hached), perineal field (crosses this section vertically).

This plan of radiation, after Holfelder, has shown itself to be the best. Naturally there are no hard and fast rules, as the details must vary from patient to patient;

ment is of particular value. In 3 cases recurrences in the sacral scar, which were completely inoperable, disappeared after radiation and did not return.

Six weeks after the wound has healed, each patient receives an after-radiation, even when the tumor, so far as we know, has been radically removed. We hope thereby to render harmless the microscopical carcinomatous nests that may have been left behind, and reduce the recidivation rate.

We have learned not to shrink from undertaking this combined therapy in even the most hopeless cases, since such cases often give astonishingly good results. Metastases in the liver and bones react well to radiation. Even though we are not in a position to cure many cases, still the roentgen radiation gives the cachectic patient, through temporary inactivation of the tumor, a new lease on life. Thus we have restored completely inoperable cases, with great liver metastases, to freedom from pain and complaints for an average of almost two years, and have rendered them able to work again for one year. Of the inoperable tumors, each one that is rendered operable by means of radiation is a great gain.

Statistics made from Schmieden's clinic at Frankfurt on Main by Holfelder and the writer, in 1919–1921, show 51 cases with cancer of the rectum treated by the combined method, the diagnosis having been proved microscopically. We treated every case, not one being refused as hopeless. Twenty-nine, or 57 per cent of them, were operable; the other 22, or 43 per cent, were inoperable. Of these 22 inoperable cases, 5 cases, or 23 per cent, have become operable by means of radiation. Of the 57 cases, 2 died as a result of the operation, and 32 died of cancer within an average of two and one-half years. Fifteen cases, or 29.5 per cent show a permanent cure after two and one-half years; 2 others show improvement.

Although the number of our cases is too small and the time of observation is too short, we find a great difference between the results of the purely surgical treatment with 10 to 12 per cent cures after three years and the combined method with 29.5 per cent after two and one-half years. But besides the statistics, we have acquired the unqualified feeling that our results have been considerably bettered as regards cures and recurrences, and even temporary improvements, so that we feel entitled to recommend the combined method of surgery and roentgen treatment. The only disadvantage of our method may be seen in the permanent abdominal anus, for we must reckon with it as a great possibility of recidivations. However, the patients quickly become accustomed to the artificial anus, and with suitable diet and a good bandage they are able to conceal their condition much better than with a sacral anus.

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DISCUSSION

Dr. Martin, Dallas, Texas. I would like to ask Dr. May to give us his technique for applying homogeneous radiation to the pelvis when there are metastases in the groins from cancer of the rectum. Such metastases are not uncommon.

I would also like to ask him whether he has ever seen a carcinoma of the rectum disappear when no more than 110 per cent of an erythema dose was applied to the tumor. As I have seen carcinoma of the rectum it has seemed a most resistant form of cancer, and I have been led to doubt the efficacy of 110 per cent of an erythema dose as a curative measure. If large doses are used, we are endangering the mucosae of both the bladder and the rectum. Bladder injuries often do not produce symptoms for a long time after the radiation is administered.

Dr. G. E. Pfahler, Philadelphia. I would just like to ask how soon after this radiation treatment of the rectum is this resection done? And secondly, I would like to ask just what the results have been in the treatment of metastases to the liver; how long the patient lived afterwards, whether the evidences of the carcinoma had disappeared, and what was the general health of the patient afterwards.

Dr. May, closing. To answer Dr. Pfahler: we resect the tumor four to six weeks after treatment in operable cases. In inoperable cases we treat the tumor with roentgen rays until it becomes operable. Cases which have advanced too far and cannot be brought back to operable conditions, should be treated as long as we think necessary to inactivate the growth and to give the patient relief from pain and discomfort.

Dr. Pfahler. What about the liver?

Dr. May. Metastases in the liver react well. Small metastases will disappear completely, larger ones can be controlled for a long time. If one does not radiate the whole liver in cases of metastases, but only the left lobe, for instance, where they mostly appear first, one can reckon, that in other parts of the organ hidden metastases start growing and impair the result. Therefore we made it a rule to treat the whole liver homogeneously with 110 per cent of the erythema dose. This seems to be difficult, but is not, when treated from three directions, one from the front, one from the side and the third field from the back, each in an angle of approximately 120 to the others. We have to use rays of high quality to obtain a high percentile depth dose. The liver can stand such radiation very well. We never saw any bad effects, such as atrophy.

(In reply to questions by Dr. Pfahler, Dr. May stated that he had treated 3 cases with large metastases in the liver and that they were free from pain and distress for two years, and had been able to work for a year; that they had all died at the end of three years and no autopsy could be made.)

To answer Dr. Martin: we give 110 per cent of the erythema dose on the tumor. You will get results if you distribute that dose homogeneously over the whole tumor and its lymphatic system. The danger lies in treating the patient with an arrangement of fields which does not bring about homogeneous action on the tumor: for instance, one place may receive 130 to 140 per cent and another 80 to 90 per cent. The main thing is to irradiate the patient homogeneously and to treat only the tumor and its lymphatic system, which cannot be done by using, for instance, two large fields, from the front and the back only. It is very important to avoid irradiating the healthy tissue as much as possible. Since we have used this method, our patients have suffered far less with roentgen sickness and have recovered more quickly.

The mucosa of the bladder is very sensitive to intensive radiation. Patients usually must urinate oftener after such treatment because of the irritation of the mucosa. When treating the bladder homogeneously one never sees an ulcer. Before and during the treatment we summon our patients to empty their bladder, and so we avoid an excessive irritation of the mucosa by the secondary rays arising from the urine.

Dr. Martin. What about the groin metastases?

Dr. May. We treat these metastases according to the case. If we cannot include the treatment of the groin with that of the primary tumor, we separate the treatments. We would then give to the groin one field with a large focus-skin distance from the front, which gives us a high percentile depth dose, or we give three fields in an angle of 120° so that the groin metastases receive 110 per cent.

Dr. Martin. Wouldn't that complicate your depth dose? That is what I am trying to get at. Wouldn't that give too much trouble in the region of the original tumor?

Dr. May. If it is possible to treat the groin metastases and the primary tumor at one time, without exposing too much of the healthy tissue to the rays, we arrange the plan of treatment from the beginning so that both places receive 110 per cent of the skin erythema dose. If the metastases are too far away to do so, we have to make out a separate plan. But if this plan would strike the plan of the primary tumor, as crossing of fields of the two plans would cause injuries, we must wait with the treatment of the metastases for six to eight weeks. That can be done without any harm, as Baensch has shown in carcinoma of the breast. After elimination of the primary tumor the metastases diminished without having been treated. If the two plans do not come into collision, they may follow each other within a short interval, as they do, for example, in treating a case of carcinoma of the rectum and its metastases in the liver.

THE ROENTGEN-RAY TREATMENT OF FIBROIDS OF THE UTERUS AND OF MENORRHAGIA AND METRORRHAGIA NOT DUE TO MALIGNANCY*

BY JOHN D. WILLIAMS, M.D.

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THE following observations are based on the treatment of more than 500 cases of fibroids of the uterus and uterine bleeding not due to malignancy, during the past nine years. About 400 of these cases were treated in my own laboratory, the remainder being hospital cases.

E. C. Titus, Pfahler, Sterne and Case were among the pioneers in this country in radiation therapy of nonmalignant gynecological conditions. From occasional reports of a limited number of cases there has grown up an extensive literature on this subject, especially since the introduction of radium. Sufficient time has elapsed, and the number of cases has grown so large, that it should be possible to determine with some precision the indications, contraindications, and results to be expected in this group of cases.

Cases in which this form of therapy is indicated are as follows:

(1) Fibroid tumors of the uterus, except the pedunculated submucous type, or those showing degeneration.

(2) Functional menorrhagia and metrorrhagia of adolescence.

(3) Menorrhagia and metrorrhagia without evidence of gross pathology and most commonly observed in the fourth decade.

(4) Menorrhagia and metrorrhagia due to metritis or endometritis of hypertrophic or polypoid nature.

A contraindication for this treatment is infection, active or latent, in the pelvis. An old quiescent infection may be converted into an active process by radiation therapy. When there is some complicating lesion requiring surgery for relief, this form of treatment should be used only as an adjuvant, for instance, to check hemorrhage.

From the foregoing observations it should be realized that a complete pelvic examination should be made by a competent diagnostician before instituting this treatment. The most favorable time for treatment is soon after a menstrual period. The bowels should be cleared, and the patient should be on a light diet before and after the treatment. There should be no metallic salts in the gastrointestinal tract. The bladder should be emptied before beginning treatment.

Up to two years ago the technique consisted of treating through a number of small areas after the cross-fire method. Treatment was given through six areas, 2½ in. square over the lower abdomen, the rays being directed through each area toward the uterus and ovaries. The factors were: spark gap, 9 in.; 5 ma.; distance, 9 in.; filter, 4 mm. Al.; 6 min. over each area. This was repeated every four weeks until the desired result was obtained. Where there was a large fibroid present, the areas were enlarged so as to include the entire tumor in the combined areas. About two years ago a new technique was developed which has been constantly used since that time. Instead of using multiple portals the treatment is given through a single large one. Where there is a large tumor present, the portal is sufficiently large to include the entire tumor. In the ordinary cases, without a large tumor, the portal is 10 by 15 cm., the long diameter being transverse to the vertical axis. The lower margin of the opening is level with the top of the symphysis. The factors are: 9 in. spark gap, 125 kv.; 5 ma; distance 37½ cm. (15 in.); filter, ¼ mm. cu. and 1 mm. Al.; time, one hour. The copper filters used were made up as ¼ mm., but actual measurement by micrometer shows them to be .275 mm. In addition to the filter mentioned above there is some slight additional material consisting of pads made up of eight sheets of cotton wadding in the form of small quilts. These pads I have used for years under the lead protection used on patients. This eliminates static, and patients are more comfortable than with lead in direct contact with the skin. About 150 cases have been treated with this technique. This amount of treatment rarely causes a reaction in the skin, and if so, it is very slight. When it is desirable to induce the menopause, this treatment is repeated, after a lapse of two or three days, through the posterior pelvic region. In patients over forty, two hours of this treatment given as indicated above will induce the menopause.

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* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

In patients under forty suffering from excessive flow, and in whom it is not necessary or desirable to induce the menopause, a single treatment is given and repeated in four weeks if necessary. A certain percentage of these cases shows improvement after a single treatment, whereas others may flow more profusely at the next menstrual period. Usually after the second treatment the flow diminishes and menstruation becomes normal or somewhat less than normal. If the result desired is not obtained, a third treatment is given about two months after the second; that is, at the end of the second menstrual period following the preceding treatment.

A fibroid uterus the size of a five-months' pregnancy will not be palpable above the symphysis and will be but little above normal size after four treatments. Larger tumors extending to the navel or above gradually diminish in size, the full effect of the treatment not being realized in less than one year.

Radiation therapy controls hemorrhage in these cases through its effect on the ovaries and on the development of the Graafian follicles. There is still some diversity of opinion as to whether the reduction in size of a fibroid uterus is due to the direct action of the rays on the tumor or whether it is secondary to the effect on the ovaries, it having been known for a long time that these tumors do diminish in size after the menopause. From my own experience, I believe that the reduction of the tumor is due to the direct action of the rays. Early in 1917 I began the treatment of a patient, aged thirty-four, with a fibroid about the size of a five months' pregnancy, the uterus extending to a location midway between the symphysis and the navel. After a series of three treatments, one month apart, this patient had a temporary cessation of menstruation, lasting three months. She then began to menstruate and has continued to menstruate normally since that time. At a recent examination by a gynecologist, the uterus was found to be normal in size. Did her uterus return to normal as a result of the temporary menopause, and if so, why did it not again enlarge with the return of ovarian function? I believe the reduction in this case, which began before the menopause, was due to the direct action of the rays.

Several cases subjected to radiation therapy by me, have later given birth to healthy children. The most recent case is that of a married woman aged thirty-one and mother of two children. About eighteen months ago she was referred to me for treatment for metrorrhagia, after having been curetted several times without relief. After two treatments, she ceased to menstruate for two months and then menstruated normally for two months, after which she became pregnant, and was recently delivered of a normal healthy child.

After roentgen-ray therapy of any portion of the body it is very important to warn the patient against any irritating applications to the skin. Of all these cases treated by me only one had a serious reaction in the skin. This occurred several years ago and was due to the fact that, for some unknown reason, this patient painted the entire abdomen with iodine soon after she had received a third treatment designed to induce the menopause. This combination resulted in necrosis of the skin over the area treated and necessitated excision of this area with suture of the healthy skin, the patient making a prompt recovery.

If, after roentgen-ray therapy, the patient complains of pain in the pelvis, especially if it be unilateral or develops fever or chills, the treatment should be discontinued. These symptoms indicate the presence of some infectious process in the pelvis which has been overlooked. A single treatment will probably not seriously activate a latent infection, but repeated treatments most certainly would do so.

On looking up the literature on this subject, I observed that Dr. E. C. Titus in the discussion of a paper by Pfahler in 1913 was apparently one of the first to mention radiation sickness in these cases, which he described as a toxemia. About 25 to 30 per cent of cases treated by the above-described technique suffer from radiation sickness. In most cases this consists of slight nausea usually disappearing in twenty-four hours. A very small percentage vomit a few times, from six to twelve hours after the treatment. If this is at all distressing, subsequent treatments are divided by giving two treatments of thirty-five minutes with a two-day interval instead of a single treatment of one hour.

One should endeavor not to induce the menopause if it is possible to give the relief desired without doing this. In my experience, the symptoms due to an artificial menopause are more pronounced than when the same occurs naturally.

After it was demonstrated that the roentgen-ray treatment of mild gynecological lesions was capable of giving relief without surgery, many gynecologists took up this work and developed a technique for the use of radium. While similar results to those obtained through roentgen-ray therapy may be obtained by the intra-uterine use of radium in many of these cases, I believe there are many reasons why roentgen-ray therapy should be the treatment of choice. Where radium is used, the patient must go to bed and usually to the hospital. In most of the cases an anesthetic is necessary. After radium, the radiation sickness is more pronounced than with roentgen-ray therapy. Many of the patients have irritability of the bladder and rectum and pelvic pain. Radium treatment is followed by a leucorrhea lasting several weeks. In young women, because of fear of inducing the menopause, a single treatment may not give relief, necessitating a second hospital visit, anesthesia, etc. The danger of activating a latent infection is greater with radium. The possibility also of introducing infection must be considered, where a foreign body is left in the uterus for some time. With roentgen-ray therapy there is no interruption to the ordinary routine life of the patient.

DISCUSSION

Dr. H. J. Ullman, Santa Barbara, Cal. There was a point brought up at the end of the paper which I think merits a little discussion, and I hope will bring out some experiences from some of the other men. That is the comparative expediency of radium or the roentgen ray in certain cases, certain types of individuals, or certain types of fibroid uteri. In the older persons it makes little or no difference whether roentgen castration is produced or not. In younger persons it makes considerable difference. I am not referring to the possibility of rendering them sterile; I am referring to the stoppage of menstruation only, whether they are rendered sterile or not. If we place radium in a uterus, the center of radiation is at an appreciable distance from the ovaries, and therefore the endometrium will receive the largest dose at any given time, the musculature of the uterus and the fibroids will receive the next less degree of intensity, and the ovaries the least. Now, if a comparatively small dose is given, the parts will recover in the inverse order, the ones farthest from the radium will recover first, that is, the ovaries. So that if we space our radium applications properly, we will reach a point where the radium is applied before the fibroids and the uterus itself recover, and after the ovaries have recovered, taking it for granted, of course, that the original dose was below the ovarian injury dose.

In practical work you can reduce a large uterus, of the size of a three months' pregnancy, with two or three applications of radium to the size of an atrophic elderly uterus, with return of menstruation in from three to six months. The same thing can be done with the roentgen ray if a small portal is used and small fractional doses are given. This is more after the French School, where the attack is on the uterus itself rather than after the German School, where the desire is to produce castration, letting that take care of the fibroids. So that I think we should not compare radium and the roentgen ray from the radiation standpoint only; we should consider the individual in deciding which we are going to

THE TREATMENT OF CANCER: A MEDICAL RATHER THAN A PHYSICAL PROBLEM*

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WHEN a new remedy is first reported, it is hailed by many as a panacea, something that will save, not only the sufferer's life or health, but will also save the attending physician thought and labor. If the condition is diagnosed as syphilis, all the physician needs to do is to give an injection of salvarsan; if diabetes, insulin; if the diagnosis is uncertain, use pluriglandular therapy. It is soon found, however, that salvarsan, in a definite dose, is not curative for every luetic patient, that insulin requires careful study of the individual's needs to be the wonderful agent it is when properly used, and that it may be an exceedingly dangerous agent in overdosage. If all diabetic patients were given insulin in the same manner, some would be killed, some unaffected and a few benefited.

The treatment of malignant growths by the new short-wave therapy was hailed as a method, which, while not a panacea, would make radiotherapy mechanical and easy. One had only to make a diagnosis and then apply the indicated radiation. The radiation was that indicated for the tumor in question, the patient receiving very little consideration. Death from roentgen cachexia was considered a necessary evil. One read of the "carcinoma dose," the "sarcoma dose," etc., and the aim, so far as one can gather from the literature, was to put that amount of radiation into a given tumor with little or no regard for the individual who was the unwilling host. Soon reports of untoward effects appeared. It reminds one of the early days of salvarsan in massive doses. Liek[1] stated last year (1922) that the number of injuries caused by roentgen radiation was alarmingly high, even in clinics conducted by the greatest experts in this line, and that it was particularly true in the treatment of tumors by the most intensive and hardest radiation.

This attitude toward standardization in the problem of radiation dosage is natural. We are always searching for simplification in the complicated task of combating disease. The more mechanical and standardized it can be made, the less thought and labor is required. It seems to be the modern attitude in the practice of medicine, this desire to substitute the mathematics of the laboratory for the laborious weighing of all the evidence of the clinician. It is time that we attacked the problem of the treatment of cancer from the broad field of Medicine rather than from the narrow one of Physics alone. Medicine in its broadest sense includes any branch of Science that may bear on the problem. We have depended too much on physics and biophysics, although without their foundation we would be nowhere, and we must continue to depend on them to strengthen and broaden that foundation.

There has been a tendency of late to appreciate more and more the rôle of the body as a whole in the reaction of tumors to radiation. Evidence that individual differences in bodily reactions play a large, if not a major part in the favorable results of radiation, is increasing rapidly. Loeb[2] states that the main effect of radiation is one injurious to tumor cells, but secondarily bodily reaction may play a part, both through contiguous tissue reaction and through distant action. Opitz[3] has found that where the tumor alone is irradiated, with the body protected, the result is less certain than when surrounding tissues are included in their radiated area. Opitz[4] also believes that the idea of completely destroying the cancer by means of a single irradiation must be considered unattainable, except in a few incipient and especially favorable cases. He uses stimulating radiation of thymus and spleen as adjuncts to the radiation of the tumor.

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Hesse[5] thinks that the reaction capacity of the surrounding healthy tissues and the general resistance of the organism must play an important rôle in roentgenotherapy. Failla[6] states that even though the amount of radiation necessary to destroy a certain tumor is known and administered it does not follow that the patient will recover, and Ledoux-Lebard[7] does not believe that an absolutely uniform technique can be adopted, for apparently identical tumors differ widely in their sensitivity to radiation. Cannot this be explained on the basis of varying body reaction in different individuals with the same kind of tumor?

This rôle of both body and tissue reaction in radiation effects on tumors has been emphasized by Ewing.[8] He states that the rather variable response of different tissues to radiation may be greatly altered by previous structural changes and other pathological conditions, and this is especially pertinent when they concern the state of the tissues immediately adjacent to a tumor that is being irradiated. It is upon the reaction of such tissues that the result of the radiation will largely depend. To quote the same author: "The therapeutic goal varies with many complicating circumstances, and each case becomes a study in itself." . . . "The idea that anything approaching a uniform dosage can ever be established for all the various forms of cancer, or all the varieties of sarcoma, can be entertained only by those who deal with a few common types of cancer, which they imperfectly observe, or by those whose work is confined to the experimental cancer laboratory. This attempt to substitute physics for biology and medicine can only prove an obstacle in the way of sound progress in radiotherapy. The conception of a standard dosage seems to emanate mainly from the notion that radiation cures cancer by killing cancer cells. The idea is an inheritance of the old surgical point of view, that the cancer must be extirpated, root and branch." . . . "It is clear that the reaction of the tissues is an essential factor in the curative process. Under some circumstances, when this reaction fails, no amount of radiation succeeds in killing the tumor cells." He has seen tissue after heavy radiation, where necrotic stroma tissue supported well-stained and apparently viable tumor cells. He believes that the most detailed knowledge we possess indicates clearly that the curative action is not the result of a direct effect exclusively upon the tumor cells, but involves especially a peculiar reaction of the normal or invaded tissues.

Russ, Chambers and Scott[9] found that prolonged exposure of rats to radiation resulted in severe wasting and death; at a reduction in the exposure, a growing animal will retain its health, but with a diminished rate of increase of body weight. As the dose of radiation becomes less, a stage is reached when the rate of increase of body weight exceeds that of the normal animal; and, when the animal is given these very small doses, it is found to develop a state of increased resistance to an implanted tumor. They also found that if small, repeated, daily radiations were given to the inoculated animals, with the tumor area protected, there was a slowing up of the tumor growth, but that there was much less retardation if the tumor received these small doses at the same time. They believe that there is ample evidence that large generalized doses of radiation lower the normal resistance to tumor growth, but that this result is reversed when small generalized doses are given at frequent intervals, while the tumor is left un-irradiated. If the size of these daily doses was varied, it was found that the more prolonged did not give the higher immunity.

Murphy and Morton,[10] Mottram and Russ[11] and Prime[12] have shown that after very large doses of roentgen rays an immune animal becomes temporarily susceptible to carcinoma and sarcoma inoculation.

Chambers, Scott and Russ[13] found that a single, rather large dose of roentgen rays increased the susceptibility of the animals to inoculation with spontaneous rat carcinoma.

There is a physical factor which is, as a rule, only considered from the viewpoint of penetration, the ability to place radiation at a given depth, i.e., the wavelength. It is generally considered true that the effect produced is entirely due to the quantity of radiation absorbed and is independent of the wave-length. The preponderance of evidence is, at present, in favor of this, but there are certain considerations that, in the author's opinion, suggest that further work may alter our viewpoint. Coliez[14] has found that with either radium or roentgen rays, as the wave-length decreases, the difference between the lethal dosage for healthy cells and that for cancer cells seems to increase. We all know that with long-wave, aluminum-filtered radiation permanent epilation occurs. The author has yet to see permanent epilation after short-wave, copper-filtered radiation even when there is severe reaction with erythema, edema, scaling and tanning. As the velocity with which an electron is driven from an atom is a function of the frequency of the incident radiation, and as higher frequencies are required to affect inner-ring than outer-ring electrons, it is reasonable to expect that the higher frequencies should produce somewhat different effects from the lower ones. An electron leaving an atom at a high velocity is more likely to travel a great distance than is a slower one before recombining, is less likely to recombine with the same atom and more likely to produce disturbances in neighboring atoms. Electrons dislocated from inner rings are more likely to produce fundamental changes in their atom than those from outer rings. It is sometimes possible to produce better effects with gamma rays in certain instances than with roentgen rays, and these rays differ only in their frequency.

If we consider the evidence we have today, we must conclude that it is preponderantly in favor of the following hypotheses:

1. That tumor cells are not killed in the ordinary sense by radiation.
2. That to obtain a cure, we must give not only a quantity and quality of radiation that will be detrimental to the tumor, but also one that will not break down the bodily defenses.
3. That the proper dosage should stimulate bodily resistance or reaction in addition to injuring the tumor cells.
4. That heavy radiation renders the body, as a whole, more susceptible to tumor growth, while light radiation makes it more resistant.
5. That the proper or optimum radiation in any given instance depends not only on the type of tumor cell but on all factors which involve the physical condition of the host—his ability to react in the desired manner.

In short, it means that we must approach the cancer problem as clinicians in the broadest meaning of the word. We must realize that we are treating an individual afflicted with cancer rather than simply treating a cancer. What advantage is there in giving a dose that would cure the cancer provided the patient lived long enough, only to have him die, not of his cancer, but of roentgen cachexia, or to so reduce his bodily resistance that he dies of the cancer in less time than if untreated? Is it not better to inhibit the growth from year to year, giving the patient several years of comfortable existence than to cure it and shorten his life? Let us consider our patients from the standpoint of the physician and choose that treatment which will give them the most comfortable existence for the longest time. Would it not advance our knowledge faster to cease searching for the carcinoma dose and determine the best treatment for certain types of individuals with given forms of tumors, rather than the best treatment for each form of tumor itself? Should we not look for certain optimum general reactions, rather than skin erythemas, and should we not combine, in every case, all factors tending to increase bodily resistance rather than depend on treating the tumor alone?

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CONTROL OF HYPERTHYROIDISM*

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THE efficiency of roentgen-ray treatment for the relief of hyperthyroidism is proven. We shall not discuss this phase of the problem but shall attempt to point out some of the medical factors, the recognition of which is essential to carry roentgen-ray treatment to a successful cure. Before any case is accepted for roentgen-ray treatment the doctor must be protected; first, by accurate and complete diagnosis; second, by a knowledge of how much irreparable damage has been done; and third, in order that he may know what to promise the patient, and what not to promise.

Hyperthyroidism is not a simple entity localized to changes in the thyroid gland. It constitutes a disturbed balance of endocrine secretions, with consequent far-reaching effects in all parts of the body. Its causes are not confined to the thyroid gland itself, but the overactivity of this gland may be but an end-result of another disease focus. To confine treatment to the gland alone will lead to failure in many cases. Therefore as I have stated, correct diagnosis is the first essential in the handling of the case. A scrutinizing search must be made for foci of infection in the teeth, tonsils, sinuses, lungs, bowel, gall-bladder, urogenital system and other parts of the body. Any focus present must be eradicated. Then again the diagnosis must be correct. Too often a palpable thyroid accompanied by a rapid pulse has led to the operating table for thyroid surgery. Cases of psychoneuroses may be totally masked by a pronounced hypertrophic goiter which is non-toxic. These non-toxic, neurotic patients with simple thyroid enlargement are dangerous pitfalls to the aggressive surgeon or enthusiastic internist, and often constitute a difficult thyroid problem, for they are definitely damaged by removal of thyroid tissue or loss of gland function. Such cases present themselves with rapid heart action, general nervousness, tremor, anxious look and a slightly enlarged thyroid, closely simulating a thyrotoxic syndrome. Frequently such individuals are extremely eager for radical treatment and encourage the prospect of a surgical operation. A mistaken diagnosis would lead to far less harm with roentgen-ray treatment than with a surgical operation entailing the sacrifice of such valuable tissue as that of the thyroid gland. But even unnecessary loss of gland function by the conservative roentgen-ray treatment is to be avoided if possible.

In the differential diagnosis, the determination of the basal metabolic rate is absolutely necessary. No case should ever be treated over any length of time without such a determination. Cases may occur where the patient is too nervous or too weak for such a test to be successfully carried out, and in such instances the treatments may be started, but should never be frequently repeated without the metabolism determination being made. To interpret correctly the metabolism test reading, the clinical course of hyperthyroidism must be understood. The hyperactivity occurs in waves or cycles. On one day the symptoms may all be very exaggerated and the metabolic rate proportionately high; on another day the symptoms may be much relieved and the metabolic rate proportionately low. This fact must be thoroughly recognized in both the diagnosis and the treatment of the case. The initial metabolic rate of a patient with exophthalmic goiter may be much higher than the subsequent tests, and even after a rest of ten days or more in bed the fluctuation from one day to the next may be as great as 20 per cent. The presence of fever must always be closely noted. It has been observed by Du Bois and his co-workers that with an increase in body temperature the basal metabolic rate rises in definite proportion to the temperature. If the temperature remains elevated and the food intake is not increased a proportionate amount, the patient will necessarily lose in body weight. In such cases there is an increased body

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A preliminary paper bearing upon this subject was presented before the Radiological Society of North America on December 7, 1922 (Measurements on Two American Deep Therapy Machines, with Special Reference to the Duane Method. *J. Radiol.*, July, 1923) by one of us (Pfahler), in which was described the detailed steps used in making measurements by the Duane method. The method has been more scientifically described by Prof. Duane in various papers (Duane. AM. J. ROENTGENOL., March, 1922, July, 1922, and Dec., 1922, and in its principle in 1914).

This description will not be repeated here. We regret that the entire object of this paper cannot be realized because of various difficulties, and we hope that some physicist will succeed in working out this data. It is extremely difficult to make exact comparative measurements of such a character in association with a crowded clinical practice. Primary voltage changes, atmospheric variations and disturbances in the individual machines occur from day to day and hour to hour, and unless all measurements are made simultaneously, or each factor controlled and all errors eliminated, the measurements have little scientific value. Therefore if we give some of our practical observations as clinicians we will probably accomplish more than to publish a great mass of figures which are not in entire accord.

1. We found that on its arrival in March, the natural discharge of the iontoquantimeter—in the absence of any radiation—was 25 minutes. In June, the discharge of the 10 units on the electroscope took place in 12 minutes. At no time did the measurements of the iontoquantimeter accord with our clinical observations as to the erythema dose, under the conditions of the test. For instance, our maximum erythema dose as given on the Rieber machine measured only 53 units on the Friedrich iontoquantimeter, even when this larger natural leak was considered. Therefore if one gave upon this basis 170e as measured by this instrument, the dose given would have been 320 per cent of what we consider our maximum dose. This naturally has led us to discard it, for the present at least.

The practical point of this is that one cannot import such a delicate measuring instrument, even of the highest grade, and consider it entirely reliable. It should be carefully investigated by a physicist and standardized before dependence is placed upon it. Fortunately we were able to control it by our known dosage, and also a known measurement. My instrument was examined by two physicists. They differed as to the fault, and the cost of repair was estimated at from $100.00 to $150.00, with no guarantee of efficiency. The primary cost to me was $442.00. Such experiences lead us to conclude, with Dr. Coolidge, that the average clinician had better depend upon the indirect method of measurement than upon ionization instruments susceptible to so much error.

2. In Germany, zinc instead of copper is generally used for filter. I asked Prof. Wintz the reason for this. He said it was purely a matter of economy, and that zinc was of the same filter value as copper. Zinc filters were furnished with the Symmetrie outfit; so, by means of the Duane method, we compared their absorption value with that of a corresponding thickness of copper, and could detect no difference between the two.

3. In some places a paraffin block, 10 × 20 × 20 cm. is used to measure radiation values. We found that this block added 19 per cent to the surface dose as compared with measurement in air. We then measured by comparison our water-phantom, consisting of an aluminum tank, 1 mm. thick and 25 × 25 × 25 cm. in size, filled to a depth of 20 cm. with water. This added 20 per cent of secondary radiation to the surface dose.

The practical point about this observation is that we must always bear in mind that our surface dose will vary with the size and density of the portion of the body receiving treatment. A surface dose on an arm or hand will therefore require a longer time than a dose given over the abdomen.

4. We found that each machine worked most efficiently under certain conditions. The calculations following were based upon observations upon the four machines all made within an hour.

(*a*) *The Rieber machine* running from 220 volts, direct primary current, gives the

tifying switch. When these two machines are measured by the same instrument under exactly similar conditions in the same rooms, and excited by the same primary current, and even run simultaneously, the output is practically the same in intensity and depth value. The surface and the depth dose will therefore be the same.

Attention is called to the observations previously described in the preliminary paper by one of us (Pfahler) as to the influence of the size of the field upon the surface dose, as well as the depth dose. As an example, on the Rieber machine with 210 kv., 4 ma., 0.48 Cu., 2 mm. gl. at a distance of 42 cm. and at the surface of a water-phantom the relative value of the radiation is as follows:

Size of Field in Cm.	At Surface, Per Cent	Erythema Dose, Min.
8 × 12	76	62
12 × 16	100	47
16 × 20	105	45
25 × 25	114.5	41

CONCLUSIONS

1. In interpreting the dose values as used by one author or another, one must know not only the voltage, the milliamperage, the filter and the distance but also the type of machine used, if the indirect method of measurements is employed, and we should be cautious in interpreting the value of an unknown machine.

2. The size of the field of radiation influences not only the depth dose but also the surface dose.

3. If one of the direct methods of measurements is referred to one should know its type and also its accuracy. Careful tests of a new instrument as it comes from the manufacturer should be made, before depending upon it for clinical work.

DISCUSSION

Dr. E. C. Ernst, St. Louis, Mo. Mr. President, I think the comparisons which Dr. Pfahler made are certainly valuable. I regret only that he didn't have a disc type of rectification machine to compare. I believe none of them were of the disc type. Perhaps all of those factors must be taken into consideration to a certain extent. The question of variations in different types of machines is rather a delicate point, particularly that difference between the Rieber type and the Veifa type. Showing how they can be used to produce the same results is certainly a most valuable contribution. Theoretically that would have seemed to be the case from the measurements that have been made.

The question of surface radiation, the size of the field, changing the superficial skin iontoquantimeter measurement radiation is likewise a point that must always be taken into consideration. The point that I would particularly like to emphasize is the manner of the use of the iontoquantimeter. We all realize the many fallacies and possible dangers in its use, but after all, Dr. Pfahler's work has been by means of such a machine.

My experience with the iontoquantimeter has been that if it doesn't work well there is no need of trying to repair it. After all the iontoquantimeter has peculiarities such that if one small part or another is not made correctly it will read wrong. For the past year and a half we have made use of one particular type, the Reiniger, Gebbert and Schall. After two to three months of careful observations we finally corrected all the possible errors, and have the machine in a place where it is never moved, nothing is changed and measurements can be made at will. Previous to the treatment of every patient, a preliminary reading is made as a rule, sixteen and a half to seventeen seconds is the necessary time required for the gold leaf to pass from one section on the scale to another).

Now we use a transformer practically all day long, and every ten days to two weeks we find that some part of the machine is not as it should be, and we immediately note a slight variation in the superficial intensity. Approximately three times a day we also make a depth-dose reading; and you can readily see if you have made your early measurements with an iontoquantimeter and with the help of a physicist and established that type of an intensity, that you can duplicate it, and you know when you are not duplicating it. To me the value of the iontoquantimeter is that with the aid of a physicist we can regulate our instrument and reduplicate those observations from time to time.

Dr. G. W. Grier, Pittsburgh, Pa. Dr. Pfahler's paper emphasizes a point that I feel all of us have met. That is that we are depending for something very important and vital on measurements of apparatus about which we don't know as much as we should. I believe Dr. Shearer was right when we first began talking about the ionization chambers in stating that the average doctor is not competent to make accurate readings with this instrument. But

I still believe that use of the iontoquantimeter is the most accurate method we have of determining dosage.

Now what I believe is that no machine should be used until the dosage has been measured properly. But I believe it should be done by someone skilled in the use of that instrument. Our experience with the Friedrich Iontoquantimeter has really been very satisfactory. We have not given 100 per cent dosage as measured with that instrument. We have found that 90 per cent of the dose as thus measured gives quite an erythema, of which the patient complains, but not seriously.

Now we know from experience that the dose as measured with the Friedrich instrument is the limit and the dose indicated with another instrument has been practically 100 per cent more or double that dose. If we gave the dose as measured by the second instrument on faith as represented to us by those who sell it we would be in serious trouble. We need to be guided by common sense and not accept readings of instruments to take the place of medical knowledge.

I would like to ask Dr. Pfahler a question. If we would use the factors with which we are familiar, that is, the voltage as measured possibly by a sphere gap and the milliamperage, the time, distance and filter, and use them after a dose has been decided with the use of some of these instruments of precision in the hands of some one skilled, would we not be better off than if we tried to use an iontoquantimeter, for instance, ourselves, as a measure of the dosage?

Dr. Henry Ullmann, Santa Barbara, Calif. I have had about two years' experience with an iontoquantimeter. Those of you who are just starting out or are having considerable trouble with such an instrument might be glad to know of the difficulties you may encounter. In most of the instruments the lead in wire passes through sulphur or paraffin. I have had to take the conducting tube apart twice, remove the sulphur and repack it, because of leakages due apparently to some chemical change occurring on the surface of the sulphur blocks. There was a discoloration. I didn't go any farther than that, but simply drilled it out and recased it.

Another thing: At first I wanted to be sure that I was using it as do physicists, who have given us certain standards. Therefore, I attempted to use tests that had already been published. I soon found that it took a number of hours of observations and then an averaging of them to come anywhere near the figures given in the literature. When this was done they tallied very closely. My last set of measurements, which involved only the reading between the surface and one point at the depth with one standard field, required over five hours. The first observations did not tally with the published tables, but after averaging this large series of observations they were found to check.

So do not accept your first readings on any machine or with any instrument, but take a great many on different days and then take your average.

Dr. O. Glasser, Cleveland, O. I was very sorry to hear about Dr. Pfahler's experience with the Friedrich iontoquantimeter, inasmuch as six years ago I started with Dr. Friedrich to build his instrument and we did quite a lot of measurements in that time. After all this experience in six years, knowing all about the instruments of dosage, I must say it is hard to use the instrument ordinarily in the office. It is possible, as Dr. Ernst said, if you have the instrument in a fixed position and you know all the factors, the influence of atmospheric conditions and all those things, it is possible, after an experience of some months, to use the instrument satisfactorily.

Dr. Pfahler said that the Friedrich instrument showed a leakage of first twenty minutes and then twelve minutes. If this is the case, the instrument cannot be used at all and should be returned. Friedrich iontoquantimeters under normal conditions show a discharge in about twelve or fifteen minutes, and to handle a natural leak of twenty minutes together with this is impossible.

As Dr. Ullmann said, usually the bad insulation is the cause of this trouble and should be replaced. But I think it is impossible to judge an instrument according to observations, for Dr. Ernst and many of you have had satisfactory experience with the iontoquantimeter. I would like to mention that most of the investigations of depth doses in this country are really made with ionization chambers like Friedrich's, constructed at home, and with any kind of electrometer connected with this ionization chamber.

The Duane arrangement is a very satisfactory instrument, but it also has certain difficulties. I mentioned in Atlantic City that the large ionization chamber, and especially that one constructed of aluminum, sometimes gives rise to difficulties in measuring.

I had a letter from Professor Duane a few weeks ago in which he stated that he measured this depth dose again and got a higher depth dose of 46 or 47 per cent. This agrees very well with the measurements made by other physicists in this country.

It is not so important what instrument is used as it is to measure correctly absolute units, and to use the right depth and quantity distribution charts for these measured conditions.

Dr. Pfahler (closing discussion). First of all I want to make it quite clear that I am not condemning any iontoquantimeter, much less Professor Friedrich's. There was no intention of that, and I am very much afraid that I left that impression. What I do want to say is that you must not get one of these instruments and then on the faith of the reading go ahead and give a dose, for you are apt to do a great deal of harm either in giving too much or too little. Something may happen to the instrument to throw it entirely out between the time it leaves Professor Friedrich's, or any other laboratory, and the time it reaches your office; and yet to all outward appearances it may be in good condition.

Of course, we must use these instruments. Use the best you can get, but be cautious at the same time, especially if they differ with your clinical sense.

Dr. Grier asked if we could have a machine measured and then go ahead and use it with observations upon the indirect elements. I believe that, generally speaking, that is the best thing for us to do. There will be variations from time to time due to some fault in the machine, dirt, leakage, or something else; but you will be very much more accurate than if you attempt to use some of these scientific instruments casually and perhaps with insufficient training.

Now I believe, too, with what Dr. Ullmann has said, that we will be much more nearly accurate if we take great averages. But the mere fact that those great averages are required, and that there is a great variation from hour to hour, in my judgment, casts sad reflection upon the measuring instrument, the installment, or something else. You don't treat a patient by averages; you don't treat a patient this hour and then for six hours and the next day for six hours and then strike an average; the dose you are giving during this hour and the next hour is the one that affects the patient. I believe that the nearer we can measure the output during a particular hour, or a particular period of time, the more accurate our work will be.

I think that answers all the questions. I want it quite clear that I am not condemning the iontoquantimeter of any make, much less that of Professor Friedrich.

THE EFFECTS OF THE SHORTER WAVE-LENGTH ROENTGEN RAY ON THE GASTRIC SECRETION OF DOGS*

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THE purpose of this paper is to give a preliminary report of experiments made to determine the effects, on the gastric secretion of dogs, of the high voltage roentgen rays of short wave-length as applied therapeutically. Further work is in progress to substantiate and amplify the results thus far obtained.

Gastric secretion has been studied by various observers after direct exposure over the stomachs of animals, using the long wave-length rays, but no one, as far as we can find in the literature, has studied the effects of the shorter wave-length therapy; nor has any one studied the effects on the gastric secretion after exposure over the chest and over the lower abdomen, excluding the stomach in each case.

A review of the literature shows that Winternitz,[1] in 1910, found that radium in even relatively large doses, in radioactive water, had no influence on gastric secretion. Regaud, Nogier, and Lacassagne,[2] in 1912, found that the glands of the fundic portion of the stomach had undergone complete atrophy in a dog which had been exposed to a total of 63 Holzknecht units (3 doses of 9 H with 2 mm. of Al. filter, 1 dose of 14 H with 3 mm. of Al. filter and 1 dose of 22 H with 4 mm. of Al. filter) given in 5 doses over a course of fifteen months. They made no observations on the gastric secretion of this dog. Bruegel,[3] in 1916, in a report covering 90 cases, stated that the acidity of gastric secretion is reduced after exposure to 16 to 20 H, using a filter of 3 mm. Al. and 1½ cm. of hard rubber and a 30 cm. focal skin distance. He administered 4 to 5 H anteriorly and posteriorly over the stomach, and in fourteen days repeated the dose. He attempted to stimulate the gastric glands in cases of hypo- and anacidity by using stimulating doses of roentgen ray, but had negative results. Wilms,[4] in 1916, stated that in certain cases of pylorospasm, the roentgen ray had given some relief, which he attributed to the lowering of gastric acidity. Stephan,[5] in 1920, reported that a case of achylia gastro-pancreatica had, on being irradiated, shown some improvement in the pancreatic deficiency, but no change in the achylia. Bryan and Normody,[6] in 1921, reported 2 cases in which they reduced the gastric acidity approximately 40 per cent. Their technique was 25 ma. min., 80 kv., 3 mm. Al. filter, skin target distance 10 in., exposed over the stomach regions.

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Wachter,[7] in 1921, reported a series of experiments. The gastric acidity was in each case previously determined; on the following day a quarter of a skin-unit dose was given in ten minutes' time through a 4 mm. Al. filter. On the fourth day the gastric acidity, after a test meal, was again determined, and on the two following days the same dosage of roentgen ray was given. Then on the seventh day, another determination of gastric acidity was made. In only a few instances, after a three weeks' interval, were two more doses given. Twice the full skin-unit dose was given through a heavy filter at one sitting, but only with the same effect as secured from the divided doses. In 8 cases with normal HCl content there was a decrease, especially marked for the free HCl. In 2 cases of gastric neurosis with normal HCl content, there was an increase of HCl after two sittings, or the opposite of the rule. Four cases of hyperacidity reacted without exception with a decrease affecting the free and the total acidity in constant ratio. In an old case of gastric ulcer, the decrease of HCl was secured only after four doses. In cases with no free acidity and a trifling or medium amount of total acid, the total acidity was only once somewhat decreased. Several cases remained uninfluenced. In 4 cases with gastric neurosis, the radiation apparently acted as a stimulus, free acid appearing in each case, the total acid twice rising and twice falling. In the last two instances, the stimulating dose was apparently exceeded, resulting in depression. In 2 cases which had long been treated with 10 minims of hydrochloric acid t.i.d., without the appearance of free acid in the gastric contents, radiation coincident with the giving of hydrochloric acid resulted in a rapid appearance of free HCl. Secondary symptoms, such as vomiting, pain in the stomach and back, diarrhea, boring and sticking sensations in the stomach region, were usually transitory and did not prevent further treatments with radiation. In one case of tuberculous heritage, a continuous temperature of 40°C. or 104°F. for two weeks precluded further dosage. This author assumes this to be due to activation of retroperitoneal foci.

Seego and Rother,[8] in 1921, made a gastric fistula on a dog and also an esophageal fistula. During the experimental periods, the dog would eat food which passed through the esophageal fistula instead of into the stomach. The gastric secretion excited by the act of eating was obtained free of food substances by this method of pseudo or apparent feeding (Scheinfuetterung). They then radiated the animal, the first two treatments being the common therapeutic doses from the front, resulting in no apparent changes whatever in the gastric secretion. The third and fourth were above the therapeutic dosage, were very heavy, and resulted in a juice with increased HCl and pepsin, and especially of a much higher rennin content than normal; each time, however, this supranormal period was followed by a shorter period of decreased gastric secretion. The fifth radiation was enormous and of fatal dosage; the animal, following this, became dull, apathetic, without appetite, and unfit, of course, for a further Scheinfuetterung, except that shortly before he was killed, a feeding of raw horse flesh resulted in securing some gastric juice, poor in ferment, the anacidity being ascribed by the author to neutralization by duodenal regurgitation of alkaline content.

From this work of Seego and Rother, it does not appear likely that there would be any success in the treatment of hyperacidity by radiation, or any possibility of lessening the acid secretions of the stomach by small therapeutic doses, or that the gastric secretory function could be stimulated by any dose which would come into consideration. The conclusion may be drawn that gastric glandular tissue is stimulated by very large doses of roentgen rays, the stimulation being followed immediately by a shorter period of depression of function, from which, however, the stomach quickly recovers its normal condition.

Lawrence,[9] in 1922, concluded that the effect of radiation on enzyme action, as determined by Wohlgemuth's diastase test, is extremely slight and of no particular importance.

Warren and Whipple,[10] in 1922, found that in a dog, a unit dose of 350 ma. min. given over the thorax with the abdomen shielded, caused no clinical disturbance. A subsequent exposure of the same unit dose in the same dog, given over the abdomen with the thorax shielded, caused fatal intoxication and death in four days. They found the stomach more resistant than the small bowel.

Miescher,[11] in 1922, working on a dog with the Pawlow stomach, found that with heavy dosage he decreased the secretion of acid and increased the secretion of the rest of the gastric constituents, including pepsin. This phenomenon began on the third day following radiation, reached its maximum on the tenth day, and returned to normal in about two and a half months. Doses of equal intensity were given at three weekly intervals, resulting in almost complete suppression of all the gastric secretions, but with an unexpectedly rapid return of normal function when the radiation stopped. The pepsin curve behaved differently from both the acid curve and the curve of the other components of gastric juice, not sinking until the others began to rise again. This suggests that the different constituents of gastric juice have a certain independence and represent functional mechanisms on which radiation does not act in a similar manner. The quick recovery following the repeated radiations suggests that under certain conditions the sensitiveness of an organ by radiation may diminish.

Ivy[12] and his co-workers have recently shown that small doses of roentgen rays cannot stimulate the secretion of the submaxillary gland of a dog and that heavy doses suppress its secretory activity. The latter doses were two dog erythema doses or five human erythema doses. They found the dog skin 2½ to 3 times less sensitive than human skin, which coincides with the observations of Martin and Rogers,[13] who found that the dog's skin is 3 times less sensitive than the skin of man. The latter observers also found that the minimum erythema dose of the dog's skin when applied directly to the dog's intestines, produces hyperemia, marked contractions in all directions, and destruction and desquamation of the mucosa.

Simonetti,[14] in 1923, concluded from his experience on 11 patients that stimulating doses of roentgen rays over the stomach (he does not give the dose) are, in a majority of cases, accompanied by an increase in the free and total acidity and also peptic activity. It may occur the same day or sometimes a day or two later.

Roth and Morton,[15] in 1923, found that there was no definite effect following the radiation of pepsin solutions. The slight variations they noted would fall within the limits of experimental error.

Ivy and his co-workers, in a recent article, found that the gastric glands are not stimulated by small doses of roentgen rays, that a dosage of 110 kv. min., 5 ma. min., 30 cm. f.s.d., 1 mm. Al. filter, 6 cm. diameter portal for one hour, which amounts to from 160 to 170 per cent of a dog's erythema dose, causes hyposecretion and achylia and marked reduction in the pepsin secretion, mucus only being secreted; that the acid curve was affected before the pepsin; and that after three to four weeks the gastric secretion returns to normal acidity, but is reduced permanently in quantity; and finally that the chlorides of gastric secretion are not especially altered by roentgen rays.

METHODS

In our work the so-called Pawlow pouch was used. In this method, a portion of the stomach is isolated, with the blood and nerve supply intact, and opens to the outside, so that the gastric juice can be collected and studied (Fig. 1). Two to four weeks elapsed after the operation of making the pouch, before the animals were used for experimentation. Control experiments were made, in which the gastric secretion was collected for one hour before the test meal was given, and the secretion was then collected hourly for four hours following the meal. The meal of the dog consisted of 200 gms. of raw meat, 50 of toast or bread, and 250 c.c. of milk. During all the experiments the dogs were given a bone to chew on twice a week. The hourly secretions were measured in amount, titrated for free and total acid with ·40 per cent sodium hydroxide and later reduced to degrees of 1/10th normal, in which form the readings appear on the charts; peptic activity was determined by means of Mett's method. No chloride determinations were made.

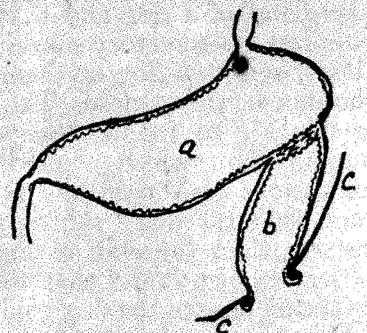

Fig. 1. Diagram of a Pawlow pouch, or accessory stomach, with nerve and blood supply intact. a, the main stomach; b, the Pawlow pouch; c, the abdominal wall.

With Dog No. 1, the daily secretions were collected for fourteen days, after which exposure was made for one hour for three days in succession, over the chest, excluding the stomach. The juice was then collected for three to four weeks and the same dose was repeated over the lower abdomen, at this time also excluding the stomach. Three weeks again elapsed and the dog was then exposed to the same dose for three days, the exposure being limited to the region of the stomach.

With Dog No. II, the same control method was used. The first exposure was a continued dose of three hours in one day over the chest, excluding the stomach. Three weeks later, this dose was repeated over the chest, the stomach being again excluded. Four weeks later the same dose was repeated over the lower abdomen, also excluding the stomach. Finally four weeks later, the region of the stomach was irradiated, using the same number of units. Following each exposure, the animal was given the test meal, after the fasting juice has been collected, as previously described.

Table I

CHANGES IN THE ACIDITY AVERAGED FOR THE DIFFERENT PERIODS FROM THE MAXIMUM DAILY FIGURES FOR EACH PERIOD

	Dog I			Dog II		
	Procedure	Free HCl	Total Acidity	Procedure	Free HCl	Total Acidity
A	Normal (11 days)	96	113.1	Normal (21 days)	81	100.4
B	Exposure over chest (3 days)	80	99.1	Exposure over chest (1 day)	112.5	137.2
C	Next 11 days	95	115.2	Next 11 days	102	112
D	Next 5 days	84	101	Next 5 days	73	89.9
E				Exposure over chest (1 day)	107.5	120
F				Next 23 days	78	93
G	Exposure over lower abdomen (3 days)	82	96.3	Exposure over lower abdomen (1 day)	93	105
H	Next 21 days	45	70.6	Next 23 days	41	68
I	Exposure over stomach (3 days)	73	88.1	Exposure over stomach (1 day)	30	80
J				Next 4 days	65	91
K	Next 21 days	32	50.9			
L	Next 28 days	0	18	Next 14 days	7	21

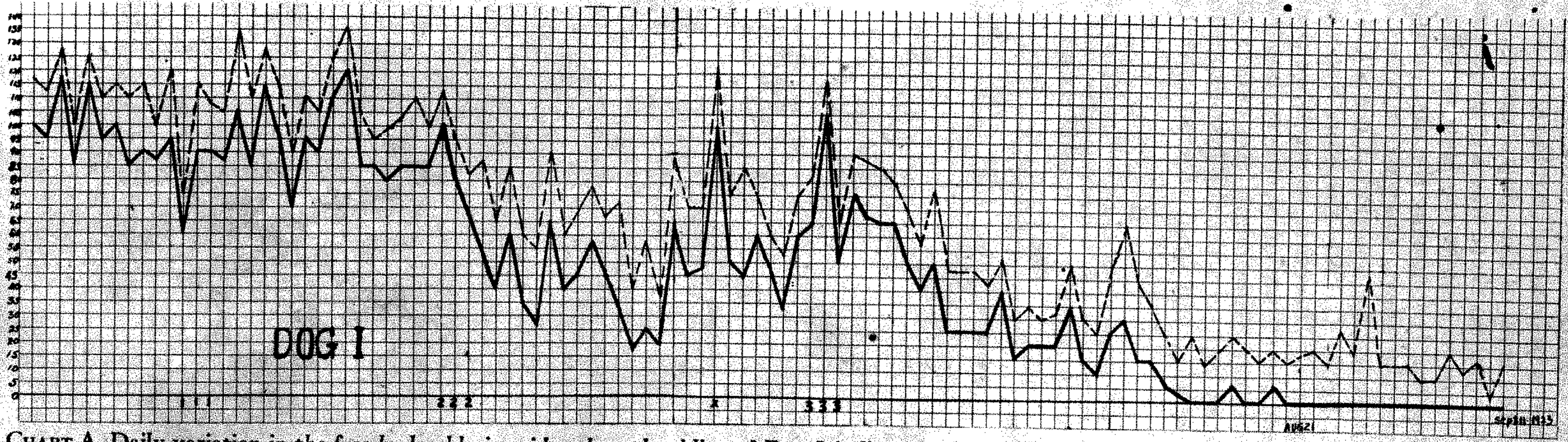

Chart A. Daily variation in the free hydrochloric acid and total acidity of Dog I indicating the maximum single titration for each day. 111, exposure over chest (3 days); 222, exposure over lower abdomen (3 days); 333, exposure over stomach (3 days). X, marked fall of outside temperature (20°).

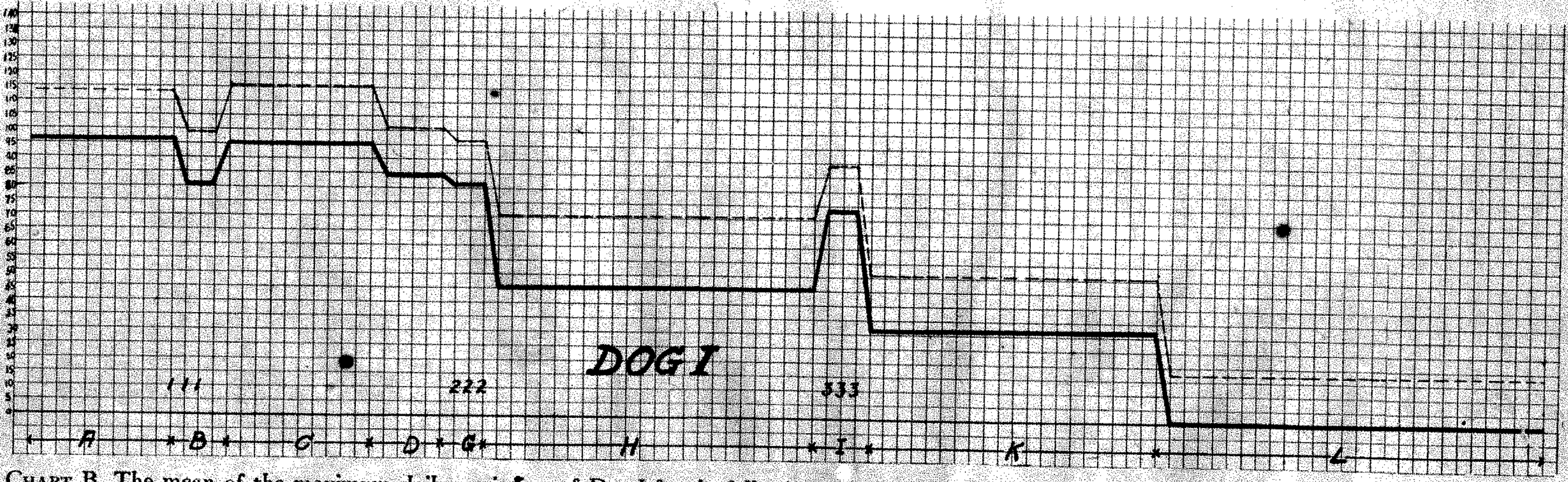

Chart B. The mean of the maximum daily variation of Dog I for the following periods: A, normal 11 days; B, exposure over the chest 3 days; C, next 11 days; D, next 5 days; G, exposure over the lower abdomen 3 days; H, next 21 days; I, exposure over the stomach 3 days; K, next 21 days; L, next 28 days.

In this way, we were able to study the effect of our unit dose of roentgen ray on the gastric secretion both before and during digestion, after the exposure over the various anatomical regions.

The roentgenologic technique was as follows:

Skin-target distance....	55 cm.
Tube voltage..........	200,000 volts
Tube current..........	6 ma.
Filter.................	0.78 mm. Cu. over 1 mm. Al.

Energy delivered to the skin per hour is 600 "e" units.

Penetration: As measured in paraffin, intensity at 10 cm. depth is 46 per cent of surface intensity.

Dog No. I
- 5-15-23 1 hour, field 14 cm. × 14 cm. over the chest, just above diaphragm.
- 5-16-23 1 hour, field 14 cm. × 14 cm. over the chest, just above diaphragm.
- 5-17-23 1 hour, field 14 cm. × 14 cm. over the chest, just above diaphragm.
- 6-6-23 1 hour, field 14 cm. × 14 cm., over lower abdomen.
- 6-7-23 1 hour, field 14 cm. × 14 cm., over lower abdomen.
- 6-8-23 1 hour, field 14 cm. × 14 cm., over lower abdomen.
- 7-11-23 1 hour, field 14 cm. × 14 cm., over the stomach, pouch at center of field.
- 7-13-23 1 hour, field 14 cm. × 14 cm., over the stomach, pouch at center of field.
- 7-14-23 1 hour, field 14 cm. × 14 cm., over the stomach, pouch at center of field.

Dose: 600 "e" units per hour.

Dog No. II
- 5-29-23, 3 hours, field 14 cm. × 14 cm. over chest (1800 "e" units).
- 6-19-23, 3 hours, field 14 cm. × 14 cm. over chest (1800 "e" units).
- 7-17-23, 3 hours, field 14 cm. × 14 cm. over lower abdomen (1800 "e" units).
- 8-21-23, 3 hours, field 14 cm. × 14 cm. over stomach (1800 "e" units).

It will be noted that this is the same technique used for human therapy and no recognition is taken of the fact that the skin of the dog is one-third as sensitive as the skin of man.

In Dog No. I, giving the divided doses over the chest had little, if any, effect, except that of slight stimulation (Chart A and B and Table I). It is to be noted that after each exposure over the chest, there was an increase of gastric function above the level of the previous day. After the exposure over the lower abdomen, avoiding the stomach, there was a marked decrease in the free and total acidity. Only once during this period did the curve reach anywhere near its former height; on that day there was a drop of outside temperature of over 20°F., which may have had some effect on these dogs. Immediately following radiation over the region of the stomach, it is to be noted that the acids again reached the level of the control period, but from that day on there was a gradual drop to achylia or to almost complete achylia.

In Dog No. II following the first massive dose over the chest, the gastric secretion was stimulated for a period (Charts C and D and Table I). We therefore repeated this dose over the chest to see if we could again get the stimulatory effects, but during the latter experiment, the curves did not rise as high as after the first exposure. After the dog had been treated over the

TABLE II

TO SHOW THE HOURLY VARIATION IN THE ACIDITY AND PEPTIC ACTIVITY IN A SINGLE DAY CORRESPONDING TO THE DAILY VARIATIONS GIVEN IN TABLE I

Dog I

	Procedure	Free HCl	Total Acidity	Peptic Activity
A	Normal			
	Fasting 1 hr.	10	23	5.87
	Meal 1st hr.	50	70	4.12
	Meal 2nd hr.	85	105	4.32
	Meal 3rd hr.	95	110	3.82
	Meal 4th hr.	80	100	3.56
B	Exposure over chest			
	Fasting 1st hr. before *x*-ray	0	27	1.62
	Fasting 1st hr. after *x*-ray	0	25	2.18
	Meal 1st hr.	65	77.5	4.00
	Meal 2nd hr.	90	107.5	3.75
	Meal 3rd hr.	82.5	95	4.12
	Meal 4th hr.	65	77.5	3.12
C	After chest exposure			
	Fasting 1st hr.	12	20	3.62
	Meal 1st hr.	82.5	95	5.87
	Meal 2nd hr.	92.5	110	6.66
	Meal 3rd hr.	90	106	5.00
	Meal 4th hr.	40	55	3.62
D	Next 5 days			
	Fasting 1st hr.	10	30	3.5
	Meal 1st hr.	55	77.5	4.5
	Meal 2nd hr.	85	95	5.3
	Meal 3rd hr.	80	95	4.8
	Meal 4th hr.	75	100	3.5
G	Exposure over lower abdomen			
	Fasting 1st hr.	25	40	6.51
	Fasting 1st hr. after *x*-ray	40	70	8.41
	Meal 1st hr.	70	87.5	7.25
	Meal 2nd hr.	85	100	4.25
	Meal 3rd hr.	80	100.0	3.82
	Meal 4th hr.	84.2	102.5	4.16
H	Next 21 days			
	Fasting 1st hr.	0	25	4.25
	Meal 1st hr.	0	25	5.00
	Meal 2nd hr.	32.5	57.5	3.50
	Meal 3rd hr.	45	70	2.75
	Meal 4th hr.	35	62.5	2.75
I	Exposure over stomach			
	Fasting 1st hr. before *x*-ray	0	10	2.5
	Fasting 1st hr. after *x*-ray	5	29.5	2.5
	Meal 1st hr.	57.5	75	4.0
	Meal 2nd hr.	75	90	2.0
	Meal 3rd hr.	65	80	3.5
	Meal 4th hr.	57.5	75	2.0
K	Next 21 days			
	Fasting 1st hr.	0	125	1.0
	Meal 1st hr.	5	20	1.5
	Meal 2nd hr.	35	47.5	3.5
	Meal 3rd hr.	40	52.5	1.25
	Meal 4th hr.	22.5	37.5	1.5
L	Next 22 days			
	Fasting 1st hr.	0	5	.5
	Meal 1st hr.	0	5	1.0
	Meal 2nd hr.	0	8	.5
	Meal 3rd hr.	0	8	.7
	Meal 4th hr.	0	10	.9

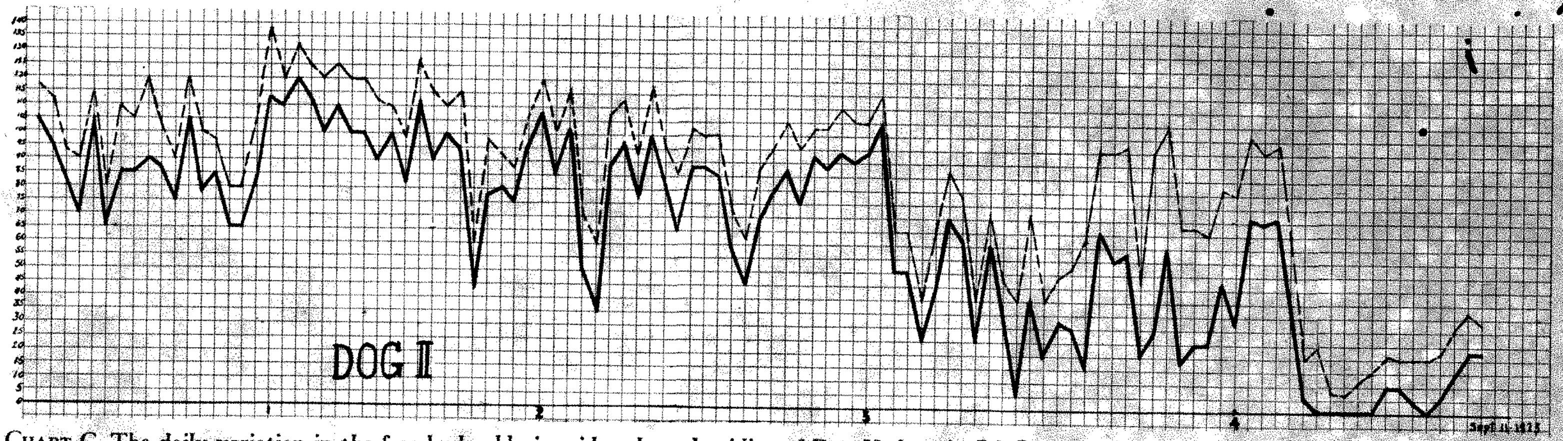

CHART C. The daily variation in the free hydrochloric acid and total acidity of Dog II denoting "the maximum single titration for each day." 1, exposure over chest (1 day); 2, exposure over the chest (1 day); 3, exposure over the lower abdomen (1 day); 4, exposure over the stomach (1 day).

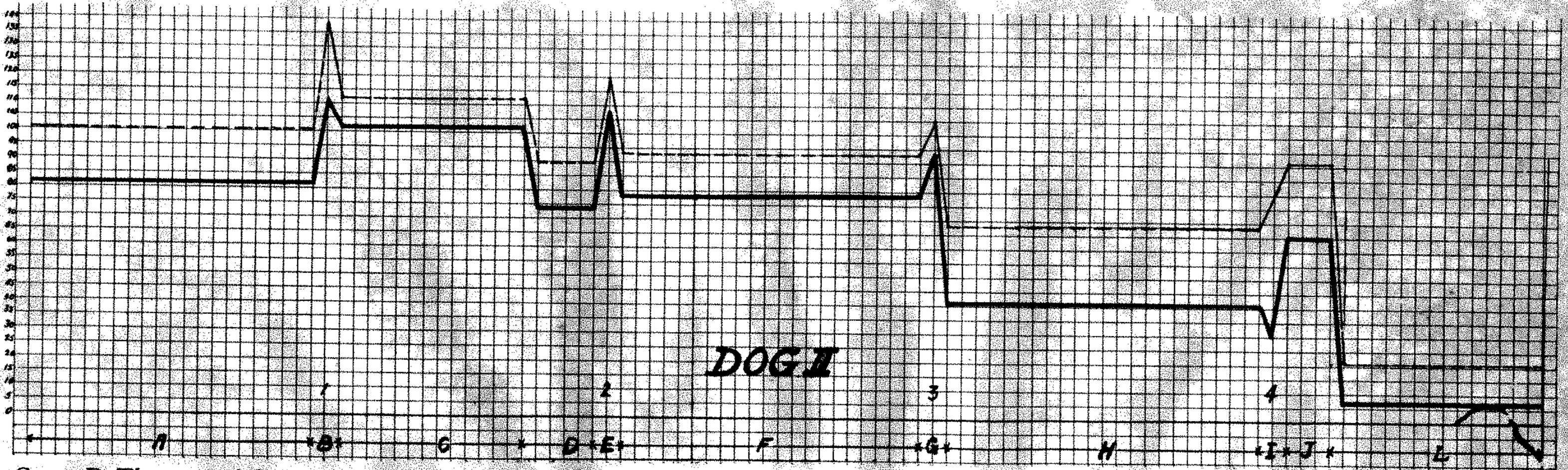

CHART D. The mean of the maximum daily variation of Dog II for the following periods: A, normal (21 days); B, exposure over the chest (1 day); C, next 11 days; D, next 5 days; E, exposure over the chest (1 day); F, next 23 days; G, exposure over the lower abdomen (1 day); H, next 23 days; I, exposure over the stomach (1 day); J, next 4 days; K, next 14 days.

TABLE III
Dog II

	Procedure	Free HCl	Total Acidity	Peptic Activity
A	Normal			
	Fasting 1st hr.	0	25	5.81
	Meal 1st hr.	45	60	9.1
	Meal 2nd hr.	75	100	5.75
	Meal 3rd hr.	85	100	4.37
	Meal 4th hr.	80	100	3.87
B	Exposure over chest			
	Fasting 1st hr. before *x*-ray	12.5	18	9.50
	Fasting 1st hr. after *x*-ray	62.5	92.5	8.00
	Meal 1st hr.	110	125	7.33
	Meal 2nd hr.	112.5	125	4.00
	Meal 3rd hr.	112.5	137.2	2.00
	Meal 4th hr.	105	125	2.00
C	Next 11 days after exposure			
	Fasting 1st hr.	0	25	5.83
	Meal 1st hr.	60	85	6.00
	Meal 2nd hr.	100	117.5	3.60
	Meal 3rd hr.	87.5	105	5.12
	Meal 4th hr.	100	120	2.87
D	Next 5 days			
	Fasting 1st hr.	0	7.25	4.00
	Meal 1st hr.	12.5	40	3.75
	Meal 2nd hr.	37.5	55	6.12
	Meal 3rd hr.	76.5	82.5	3.25
	Meal 4th hr.	80	92.5	3.00
E	Exposure over chest			
	Fasting 1st hr. before *x*-ray	10	15	5.00
	Fasting 1st hr. after *x*-ray	10	37	4.00
	Meal 1st hr.	62.5	80	5.00
	Meal 2nd hr.	77.5	92.5	4.00
	Meal 3rd hr.	105	120	5.00
	Meal 4th hr.	107	120	8.00
F	Next 23 days			
	Fasting 1st hr.	30	50	3.5
	Meal 1st hr.	42.5	62.5	6.75
	Meal 2nd hr.	62.5	77.5	8.00
	Meal 3rd hr.	80	95	4.00
	Meal 4th hr.	77.5	95	4.25
G	Exposure over lower abdomen			
	Fasting 1st hr. before *x*-ray	6	15	3.0
	Fasting 1st hr. after *x*-ray	0	10	3.25
	Meal 1st hr.	25	50	3.75
	Meal 2nd hr.	55	77.5	5.00
	Meal 3rd hr.	65	85	2.00
	Meal 4th hr.	93	105	3.0
H	Next 23 days after exposure			
	Fasting 1st hr.	15	30	2.5
	Meal 1st hr.	17.5	35	2.5
	Meal 2nd hr.	30	50	2.0
	Meal 3rd hr.	35	52.5	3.0
	Meal 4th hr.	45	65	2.5
I	Exposure over stomach 1st day			
	Fasting 1st hr. before *x*-ray	0	12	2.6
	After *x*-ray	0	6	3.0
	Meal 1st hr.	32	80	3.5
	Meal 2nd hr.	30	80	3.0
	Meal 3rd hr.	12	42	2.5
	Meal 4th hr.	15	21	2.5
K	Next 4 days			
	Fasting 1st hr.	38	56	1.5
	Meal 1st hr.	35	75	1.6
	Meal 2nd hr.	66	80	1.7
	Meal 3rd hr.	78	93	1.0
	Meal 4th hr.	76	98	1.0
L	Next 14 days			
	Fasting 1st hr.	0	7	1.82
	Meal 1st hr.	5	20	1.5
	Meal 2nd hr.	0	25	0.5
	Meal 3rd hr.	0	24	0.5
	Meal 4th hr.	5	23	1.0

lower abdomen with the massive dose, avoiding the stomach, there occurred a marked diminution in the free and total acidity. Following the treatment of the massive dose over the stomach itself, there was an even more rapid decrease in the free and total acidity, so that achylia or near achylia developed within a few days after the treatment. This effect is to be compared with that obtained in Dog No. I, in which, after the divided dose, it required a period of nearly two weeks to reach achylia or near achylia. The peptic activity of these dogs was affected very little, if any, by exposure over the chest and the lower abdomen, but it was diminished when the dogs were exposed over the stomach. The decrease, however, did not manifest itself until after the acid curve had shown a marked drop. Both dogs showed a slight diminution in appetite after the exposures. Dog No. II, which received the massive dose, showed a more marked decrease in appetite, but soon returned to normal after each exposure. Neither dog had lost appreciably in weight during the four months included in this series of observations. They were nearly as lively at the end of this period as they were before the experiments were begun.

From the results of these experiments, we infer that little, if any, damage is done to the gastric secretion of dogs when the latter are exposed over the chest to short-wave roentgen rays in such dosages as are usually applied therapeutically to human beings; that there is a marked lowering of both free and total acidity when exposure is over the abdomen; and that there is absence, or practically an absence, of free acid when exposure is directly over the stomach. If a dog's skin is one-third as sensitive as that of man, then we feel that it is justifiable to conclude that we ought to expect more marked changes in a human being who has been submitted to the same dose over the same period of time.

We are not at this time prepared to present the report of the pathological changes that have gone on in these animals; these changes will be embodied in our later report of the work.

CONCLUSIONS

1. The human dosage of the shorter wave-length roentgen-ray therapy, when applied over the chest of a dog, has little or no effect, except a transient stimulation of the gastric secretion.

2. Gastric acidity is markedly lowered when the exposure is over the lower abdomen below the stomach.

3. Achylia or near achylia is produced when the stomach itself is exposed.

4. More damage will probably be done to human gastric glands, using the same

dosage and the same technique, than was noticed in these animals.

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ROENTGEN-RAY CACHEXIA*

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ONE of the most serious of the ill effects of intensive radiation as described in the foreign literature appears to be the so-called "roentgen cachexia" which comes on slowly and produces great emaciation. Opitz,[1] in discussing the effects of radiation, states that he believes that certain chemical substances are elaborated in the body which produce the well-known treatment sickness followed by irreversible blood changes and later by cachexia. The cachexia which occurs in dogs following the exposure of a loop of small intestine to a large dose of *x*-rays was described in a previous paper.[2] This slow emaciation appeared to resemble the clinical syndrome so closely that a more elaborate investigation was decided upon.

Even though these clinical and experimental conditions may not have the same etiology, a more detailed study of intestinal reactions following radiation should be taken up in an effort to correlate some of the conflicting evidence now appearing in published articles. There seems to be little agreement as to the actual tolerance dose for the intestinal mucosa. Schmitz[3] states that "the maximum dose that the vesical and rectal mucosae will bear without injury is 130 per cent of an E. S. D." Wintz claims that 135 per cent of an erythema dose is safe. In the face of these statements Fried[4] describes fully the autopsy findings in a case of carcinoma of the cervix that showed a rupture of the entire sigmoid which occurred following the application of 128 to 138 per cent of an erythema dose to this structure. Muhlmann and Meyer,[5] after describing the intestinal ulcers that may be produced by overradiation, give the toxic dose for the intestine as 160 per cent of the skin dose. Wintz[6] describes small ulcers that occurred in the posterior rectal wall in some of his thin patients treated over the pelvis, but states that these lesions were produced by 140 to 150 per cent of the erythema dose, which unavoidably reached the affected regions. In all probability such discrepancies are due to errors in measurement rather than to any great variation in the susceptibility of the intestine. The erythema skin dose as judged by different workers is subject to considerable variation and makes a most unsatisfactory unit where an error of 10 per cent may lead to serious ill effects. The many types of ionization apparatus in use can hardly be expected to give identical readings, and until some standard device is adopted ionization measurements will undoubtedly vary somewhat.

The determination of the intestinal tolerance dose is of great importance since certain malignant tumors occurring in the abdomen appear to be more resistant to radiation than the mucosa itself, and in such cases efficient treatment might prove disastrous to the patient. Thus Fischer[7] describes three autopsied cases in which histologically normal carcinomatous tissue was found at the site of intestinal necrosis produced by intensive radiation. Any safe treatment in such cases would apparently have been of no avail. The possibility of damaging the intestine was brought out

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as early as 1912 by Regaud, Nogier, and Lacassagne,[8] who studied the effect of cross-firing the abdomen in dogs.

Since we had no proven measuring apparatus at our command it seemed unwise to attempt a study of intestinal sensitiveness. However, it was possible to investigate the various types of injury produced in the intestine, and special attention was given to the end results.

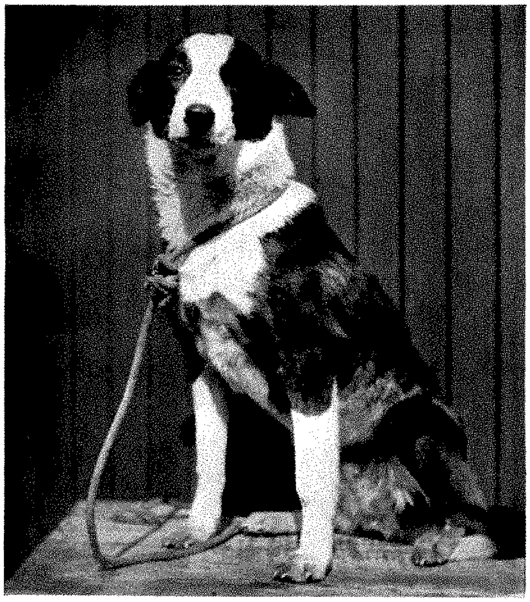

Fig. 1. Dog No. 1 one week after the operation during which a loop of small intestine received a "dog erythema dose."

Warren and Whipple[9] have described a rapid death in dogs occurring four days after radiation of the whole abdomen with doses large enough to produce destruction of the intestinal epithelium. Denis, Martin and Aldrich[10] applied approximately ⅔ of this dose to single large areas over the abdomen in rabbits and produced a rapid cachexia leading to a fatal outcome in three or four weeks. No marked gross lesions were observed in the intestines of these animals. These experiments seemed to indicate a variation in the length of life depending upon the size of the dose used when large abdominal areas were exposed. In order to examine this point, five young guinea-pigs of about the same age were placed on an animal board one after another and radiated over the entire abdomen. Each animal was secured on the board with the abdomen uppermost and a shield was placed over the head and upper thorax. A 9-in. parallel gap was used at a 10-in. focal skin distance with a filter of 2 mm. of aluminum. The doses administered were 200, 152, 100, 72 and 56 ma. min. The first three animals became very weak, developed a mucous diarrhea and died in six days. The pig receiving 72 ma. min. developed a diarrhea and a rapid cachexia, but lived three weeks. The animal receiving 56 ma. min. was watched for a month, during which time no ill effects were observed. These findings indicate that death is not produced by radiation of the whole abdomen until a certain threshold value is reached. When such a dose is administered death occurs only after a fairly long period characterized by emaciation and diarrhea. If the dose be increased still more, a rapid death occurs a few days after the raying is done. The latent period of six days which preceded death was not shortened by a marked increase in the dose.

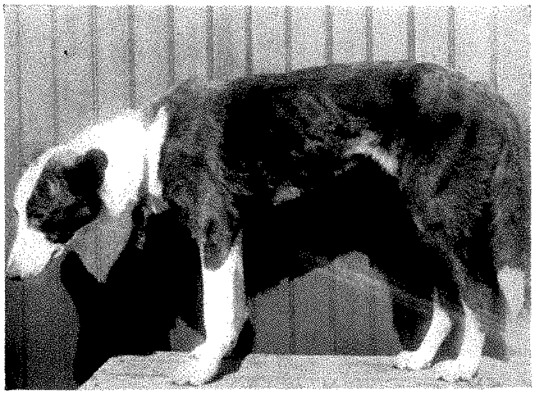

Fig. 2. Dog No. 1 fifty-three days after the radiation of a loop of small intestine.

In actual practice it is unusual to apply large doses to the whole abdomen, and therefore it seemed best to study their effects on single loops of intestine. In a previous paper,[2] the effect of the erythema dose for a dog upon an isolated loop of small intestine was described in detail. A dose of 75 ma. min. applied at a focal skin distance of 10 in. with a parallel gap of 5 in. and no filters was just sufficient to produce a reaction on the dog's skin. The human erythema dose is, of course, much smaller, but since it was our desire to study the severe reactions this dose was adopted. In our previous article attention was called to the fact that the administration of this dose to a single loop of small intestine caused no symptoms at the end of three weeks although the mucosa showed almost complete destruction at that time. The lack of symptoms made it seem imperative to study such animals over longer periods of time. Six dogs were, therefore, operated upon in the roentgen-ray laboratory, and in each instance a dose of 75 ma. min. was administered to an isolated loop of small intestine varying from 10 to 15 in. in length. The loop was brought through a small hole in a lead shield so that no other structures were rayed. One animal died of peritonitis two days following the operation and a second dog died of infection at the end of a week. The other four recovered promptly and were in good condition at the end of three weeks, at which time they appeared perfectly normal and had good appetites. Figure 1 shows the appearance of Dog No. 1 seven days after the operation. This animal did well for thirty-two days, but at the end of that period its appetite began to fail, and it seemed to be losing weight. A distaste for food seemed to develop and the weight loss became progressive until at the end of fifty-three days the animal was quite emaciated. Figure 2 shows its condition at that time. Since the lesion causing this syndrome was sharply localized it seemed reasonable to assume that resection of the affected loop might lead to recovery. An operation was done immediately. The diseased loop was resected and an end-to-end anastomosis done. The appearance of the opened resected loop is shown in Figure 3. Large ulcers showing a greyish-green necrotic surface were found along one side of the intestine. The intestinal wall was much thickened but there was no evidence of obstruction to be seen. For three days the outlook appeared bright, but on the fourth day the dog began to look sick, and on the eighth day death occurred. An autopsy revealed a peritonitis apparently secondary to a leak in the end to end anastomosis. The failure of this experiment was unfortunate, since we had hoped to demonstrate a successful method of treating isolated lesions.

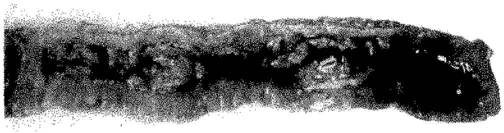

Fig. 3. Opened loop of small intestine from Dog. No. 1 removed fifty-three days after the radiation.

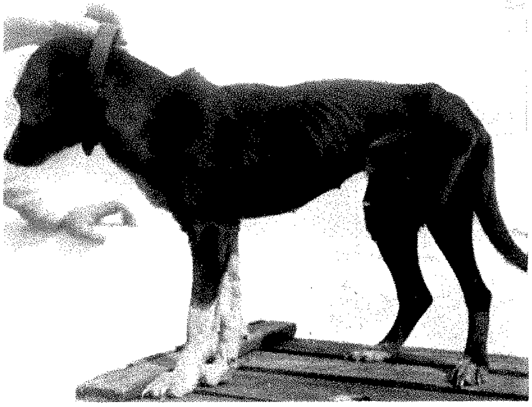

Fig. 4. Dog No. 5 fifty-eight days after the administration of a "dog erythema dose" to a loop of small intestine.

Dog No. 5 appeared to be doing well for a month following the operation but at the end of thirty-four days it showed a distaste for food and seemed to be losing weight. The emaciation soon became quite pronounced. Figure 4 illustrates the condition fifty-eight days after radiation. On the sixty-fifth day the animal was found dead. At autopsy the affected loop showed shallow ulceration of the mucous surface, with a thickening of the intestinal wall, but again there was no evidence of obstruction visible.

Dog No. 6 passed through almost identically the same stages as dog No. 5. On the sixty-fifth day the photograph shown in Figure 5 was taken. The animal was in such poor condition at this time that it was sacrificed. An autopsy revealed the characteristic ulceration as previously described. The appearance of the opened loop is shown in Figure 6. Here again no evidence of obstruction was observed.

Dog No. 4 proved to be the most interesting one of the series. This animal was an excellent specimen and remained in unusually good condition for a month following the operation. At the end of forty-one days emaciation became noticeable to a slight extent and food was taken sparingly. At the end of fifty-eight days the photograph shown in Figure 7 was taken. The dog seemed to be going down hill just as the others had done. Soon afterward it began to take more food and showed definite improvement. This improvement was progressive and it seemed that recovery was assured. Figure 8 shows the improved general condition one hundred and seventeen days after the operation. Soon after this photograph was taken the animal began to grow thin and rapidly became very much emaciated in spite of the fact that it still took food very freely. Figure 9 illustrates the advanced cachexia as it was observed one hundred and sixty-three days after the radiation. In spite of the marked loss of weight the dog was still strong enough to fight with the other dogs for its food, and ate ravenously. On the one hundred and sixty-sixth day autopsy was decided upon. When the abdomen was opened a moderate amount of clear straw-colored fluid was observed in the peritoneal cavity. The small intestine above the radiated region showed marked dilatation. The diameter of the lumen in this region was at least five times that of the normal intestine. This dilatation ceased abruptly in an indurated strip which was markedly contracted and did not measure over 1½ in. in length. The loop originally exposed was 13 in. in length. The contracted strip was markedly indurated and could be compressed very little with the fingers. The intestine below the exposed loop appeared perfectly normal. A considerable amount of fecal material was observed in the lower bowel and rectum. The appearance of the involved loop of intestine is shown in Figure 10. The radiated loop, when laid open, showed a definite stenosis, as illustrated in Figure 11. The opening was approximately $^3/_{16}$ in. in diameter and the surrounding wall was much thickened and indurated. Small shallow areas of ulceration were observed scattered along the mucous membrane on either side of the stenosis for a short distance. It would appear that this animal overcame the primary ill effects secondary to the ulceration only to be overpowered by a partial intestinal obstruction. There are then, two possible causes for cachexia following overradiation of a single loop of intestine.

Although the end-results have been

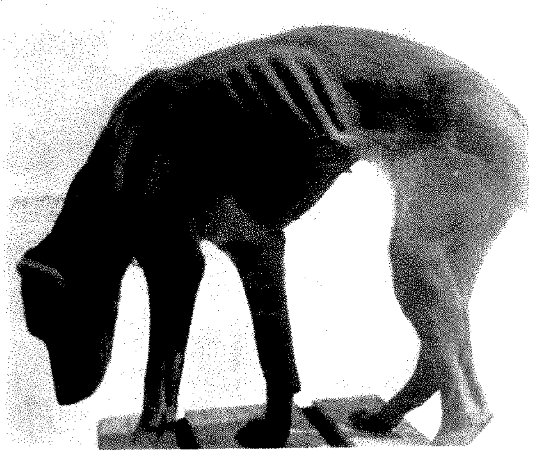

FIG. 5. Dog No. 6 sixty-five days after the administration of a "dog erythema dose" to a loop of small intestine.

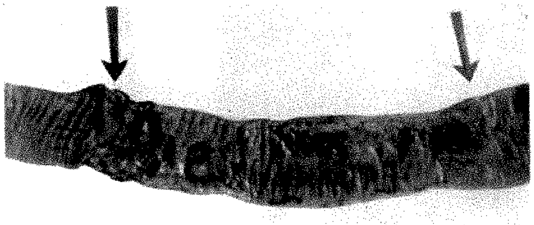

FIG. 6. Opened loop of small intestine removed from abdomen of dog No. 6, sixty-five days after radiation. There are areas of shallow ulceration in the mucous membrane.

demonstrated, the reasons for the cachexia are not easily found. The process may result from an interference with absorption or from a toxemia secondary to the absorption of toxic material from the intestinal lumen or from the ulcers themselves. The investigation of such a problem necessarily takes on considerable proportions, and we have not yet gone very far with it. The work of Mottram, Cramer and Drew[11] indicates that interference with absorption may play an important rôle. These observers were able to inhibit the absorption of fat from the intestine in rats by exposing the animals to large doses of radium. With smaller doses a partial inhibition was obtained. It was their belief that this change in absorption was secondary to a decreased leucocyte count, but we are of the opinion that the rays acted directly on the intestinal mucous membrane. In an effort to establish this point, isolated loops were exposed following operation in three dogs, according to the method described earlier in this paper. The doses administered were 15, 37.5 and 75 ma. min., the other factors being those used in the previous experiments. Fifteen ma. min. was used because it represents the minimum dose that produces a visible reaction on the human skin. After a week had elapsed with the

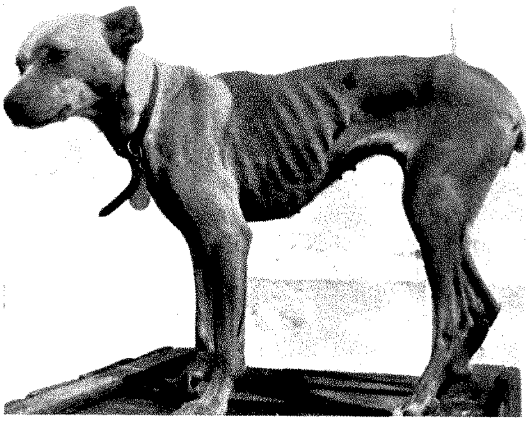

FIG. 7. Dog No. 4 forty-one days after the administration of a "dog erythema dose" to a loop of small intestine. Emaciation is becoming pronounced.

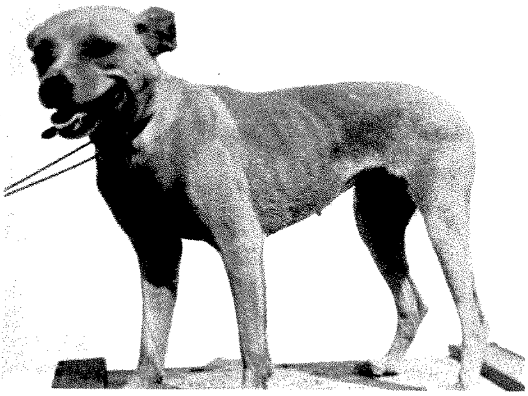

FIG. 8. Dog No. 4 one hundred and seventeen days after radiation. The animal appears to be recovering and is gaining weight.

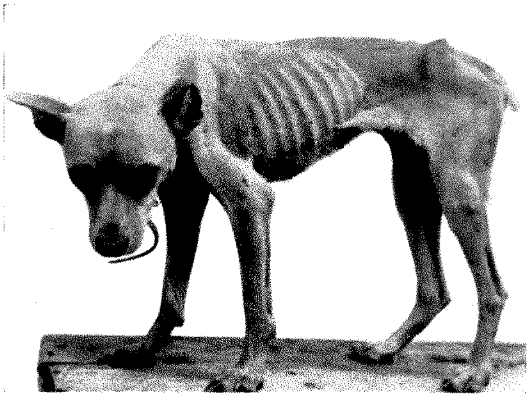

FIG. 9. Dog No. 4 one hundred and sixty-three days after radiation. The animal shows a rapidly progressive cachexia.

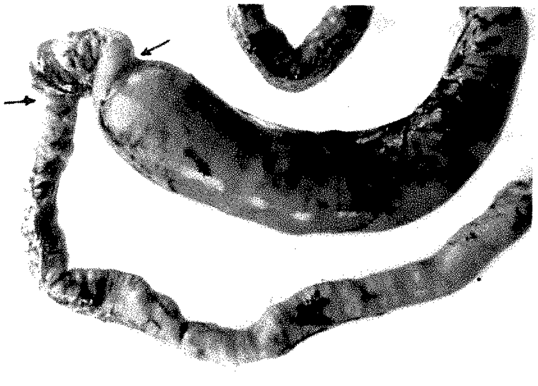

FIG. 10. A portion of small intestine removed from the abdomen of dog No. 4 one hundred and sixty-six days after radiation. The area between the arrows was indurated and contracted. The intestine above this point showed marked dilatation. The intestine below the radiated section appeared normal.

dogs in good condition each animal was fed ½ pt. of cream in the morning. Three hours later abdominal incisions were made following the administration of ether. The intestine of the dog receiving the smallest dose of *x*-rays appeared perfectly normal. The lymphatics of the mesenteries stood out in relief because of their engorgement with the absorbed fat. The other two animals showed a similar picture, except that no lymphatics could be made out in either case, in the mesenteries leading away from the exposed loops. These findings indicate that large doses of rays applied directly to loops of intestine cause a definite inhibition of fat absorption in the exposed areas. It seemed possible that this might be due to a total destruction of the epithelium, but upon opening the exposed loop that received 37.5 ma. min. the greater portion of the mucous surface showed no gross abnormalities. A few small patches of ulceration were observed as shown in Figure 12. The remaining epithelial cells had apparently lost their power of absorbing fat. The gross appearance of the unopened loop is roughly shown in Figure 13. Frozen sections were prepared from this specimen and stained for fat with osmic acid. No evidence of intracellular fat could be made out. The most striking thing observed was the marked increase in goblet cells. In fact, almost every cell of the mucous membrane was markedly deformed by a huge collection of mucus. Mottram[11] has described these changes in mucus secretion following the exposure of rats to radium rays. It was his observation that the secretion of mucus may be markedly stimulated and later inhibited completely, as the dose is increased. It seems possible that the marked increase in mucus production may be responsible for the loss of absorptive power, although we have no direct proof to offer substantiating this suggestion.

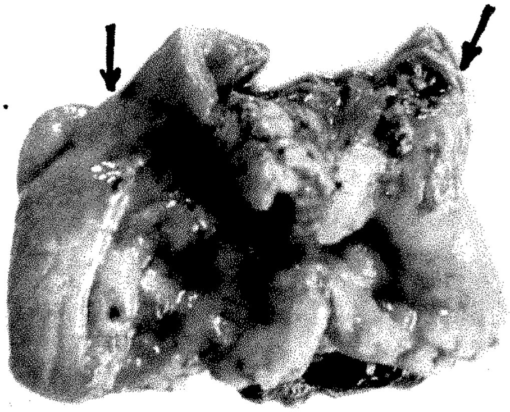

FIG. 11. The portion of bowel included between the arrows in Figure 10 has been laid open so as to show the area of stenosis which had produced a partial obstruction.

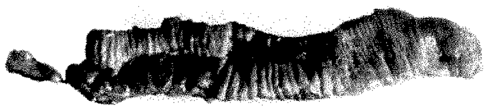

FIG. 12. Opened loop of small intestine of a dog one week after receiving one-half of a "dog erythema dose." There are patches of ulceration found in the mucosa, but some of the mucous membrane appears to be intact.

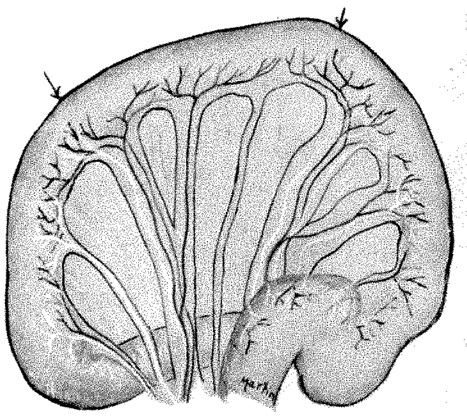

FIG. 13. Drawing representing the loop of intestine that received 37.5 ma. min. one week after exposure. The animal had a feeding of cream three hours prior to examination, but there is no fat in the lymphatics draining the exposed area.

It is also unreasonable to assume that the inhibition of the absorption of fat in a single loop of small intestine can cause cachexia when the remaining intestine is functioning normally. However, the rapid death that occurs following the radiation of the whole abdomen may be caused by interference with absorption. Such a rapid syndrome could be easily explained if it were assumed that the absorption of water is inhibited, since an animal can live only a short time without water. The rabbits studied by Denis, Martin and Aldrich[10] showed a marked fall in urine output and a watery diarrhea, which facts point toward the elimination of unabsorbed water through the rectum. Obviously, our experimental data is insufficient to explain all of the observed phenomena. It is our desire to continue these studies with the hope of explaining some of the puzzling intestinal reactions.

We wish to acknowledge the valuable assistance of Dr. B. F. Hambleton and Dr. G. C. Caldwell in our operative and post-mortem work.

CONCLUSIONS

1. A large dose of *x*-rays delivered to the entire abdomen of an animal produces a rapid death a few days after the exposure. Smaller doses produce a rapid cachexia followed by death in two or three weeks; still smaller doses produce no noticeable effect

2. A large dose of *x*-rays delivered directly to a single isolated loop of the small intestine of a dog produces a slowly progressive cachexia. The animal may succumb in approximately two months during the stage of intestinal ulceration, or after five or six months from partial intestinal obstruction.

3. Fat absorption is inhibited when heavy doses of *x*-rays reach the small intestine.

4. The output of intestinal mucus may be markedly increased by heavy doses of *x*-rays delivered to the epithelium.

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It is curious that the Japanese should have anticipated Europe in a kind of rude regional anatomy. I have seen a manikin of Japanese make traced all over with lines, and points marking their intersection. By this their doctors are guided in the performance of acupuncture, marking the safe places to thrust in needles, as we buoy out our ship-channels, and doubtless indicating to learned eyes the spots where incautious meddling had led to those little accidents of shipwreck to which patients are unfortunately liable. From Border Lines of Knowledge in Some Provinces of Medical Science by Oliver Wendell Holmes.

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Information of interest to all readers will be found on page vii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

SIR ARCHIBALD DOUGLAS REID, K. B. E., C. M. G., D. M. R. E.

The news of the sudden, untimely death in Switzerland, of Sir Archibald Reid, Honorary Member of The American Roentgen Ray Society, came as a great shock to his friends in this country. His death at this time is well-nigh an irreparable loss to radiology not only in Great Britain, but all over the world. He had been the moving spirit in the organization of the British Institute of Radiology, for which he found suitable quarters and for the realization of which he worked day and night. It was his dream that this Institute should be the nucleus for a world-wide organization to further the science and profession of radiology; that it should be a central information bureau on everything connected with radiology, and that it should be a guide to the radiologists visiting London. In contrast to his English colleagues, who hesitated and wanted to go slowly and wait till there were sufficient funds to start operations, he argued that money would be forthcoming, if organization were begun and some progress shown. Acting on this theory he selected a suitable building for the Institute and began to carry out the necessary alterations. Although he is no more, this undertaking can not go back into oblivion. Had he been less active his death would probably have delayed the Institute for an indefinite period.

His was the spirit which accomplishes things and which we on this continent like to call American. Indeed, to the few of us who knew him personally, he seemed one of our own. He was so truly human that he could have seemed a compatriot to any national group.

Sir Archibald Reid was born on July 14, 1871. He graduated in medicine in 1901 and very soon interested himself in radiology. He first worked in the *X*-ray Department of the King's College Hospital. In 1911 he accepted the position of Superintendent of the Radiological Department at St. Thomas' Hospital, which position he held till his death. In addition he was radiologist and consulting radiologist to various other hospitals. He was Joint Secretary to the Radiological Section of the International Congress of Medicine held in London in 1913. He was President of the Electro-therapeutic Section of the Royal Society of Medicine for the year 1911–12, a member of the Council of the Roentgen Society, and Chairman of the Educational Committee of the British Association of Radiology and Electrology. When the latter organization established a diploma in radiology and electrology at Cambridge University, he set an example by submitting a thesis and taking that diploma in 1920. He cooperated in founding the Society of Radiographers three years ago and became its first president, which position he held for two years.

During the entire period of the World War, from 1914 to 1919, he was Chief of the *X*-ray Service in the British Army, his position being that of President of the War Service *X*-ray Committee.

Archibald Reid

It was early during the latter year that I came in contact with him in an official capacity and it was then that I learned to respect and admire him. Although our contact was rather brief, I could not help coming under the spell of his charming personality.

Of his work as Chief of the *X*-ray Service in the army his co-workers could speak with greater authority, but I was impressed by what he had accomplished with the means at hand. It must be remembered that when England entered the World War the *x*-ray branch of the medical service was unprepared. I have even been informed on good authority that when the English roentgenologists at first offered their services they received a reply which amounted to a rebuke. Reid, however, was not discouraged by lack of official understanding of the *x*-ray needs of the army. The result was that the aforementioned committee was appointed and he was made president. The outfits available were mostly, or perhaps exclusively, coils and gas tubes. The English manufacturers had not yet gone into transformer building on the scale that the Americans had, and the Coolidge tube was as yet in its infancy. It was not even manufactured in England at the time. The radiator type tube had not yet been thought of; it was developed by Coolidge in response to our war demands early in 1917. In view of the submarine warfare and consequent uncertainty of obtaining a regular supply of *x*-ray materials from abroad, Reid was compelled to limit himself to what the English manufacturers were equipped for and had been in the habit of making, without embarking upon new experiments. When one remembers that we, 2½ or 3 years later, had to begin our work in France with equipment which we bought there, it will be easy to appreciate the difficulties encountered by him. When one realizes that he not only had to provide equipment for the western front, but also for the Galipoli and Suez Canal battlefields and later for Palestine, Syria and Mesopotamia, one can get a conception of the magnitude of his task and the difficulties which he encountered. But these could neither dampen his ardor nor crush his spirit. He was always on the alert, always cheerful, and always an inspiration to his assistants and co-workers.

His services were fittingly recognized by the British Government in conferring knighthood upon him.

During the war he edited an English translation of Ledoux-Lebard and Ombredanne's book on the localization and extraction of projectiles. Previously he wrote an article on the *x*-ray diagnosis of calculi for the 1905 edition of Rose and Carless's Surgery, and one on the treatment of rodent ulcer for Cheyne and Burghard's Manual of Surgical Treatment. He was also the author of many other contributions to *x*-ray diagnosis.

When the war was over, he, in conjunction with others, became interested in the formation of an International Radiological Organization. It was not due to any shortcoming of his that the plans have not yet been realized. The conditions of Europe and the temper of its people are such as to make difficult, if not impossible, cooperation among the older and the newly created national units. He nevertheless felt that such an organization should be created and the sooner the better. If I understood him aright, he thought that the British Institute of Radiology, which was the last great thing to which he was giving his time and his labor, would be the beginning of such an organization. He believed that it could be started by interesting those of the Allies and those of the Neutrals who would care to come in now, and that later the others would follow suit. His compatriots could provide no finer memorial to him than to make all possible effort to realize his dream; and we, in America, could show no better evidence of our love and respect for our English brethren than by helping along individually and collectively in this great undertaking.

L. JACHES.

THE DIAGNOSIS OF HEALED MILIARY TUBERCULOSIS

Acute miliary tuberculosis, contrary to widely prevalent opinion, does not always pursue a rapidly fatal course. The older literature is reviewed by Cornet in Nothnagel's "Practice of Medicine" and instances are cited in which, perhaps with initial symptoms suggestive of miliary tuberculosis, the course of the disease has been prolonged and obsolescent tubercles have been found in the lungs or other organs. The author states that in rare and very exceptional cases acute miliary tuberculosis ends in complete recovery. Wunderlich[1] described a case in which death occurred from causes other than tuberculosis four months after onset of symptoms and autopsy showed the presence of old miliary tuberculosis. Burkart[2] described instances of miliary tuberculosis in which the character of the tubercles furnished evidence that they had existed a considerable period before death; and in two instances the lungs as well as other organs contained numerous encapsulated nodules which had undergone calcification. Longcope[3] has described six instances of chronic miliary tuberculosis.

Healed and calcified miliary tubercles are not infrequently found in the liver and spleen of individuals with conspicuous healed lesions of tuberculosis in the lungs and bronchial lymph-nodes. During the period of activity a few tubercle bacilli have escaped from the primary foci and given rise to scattered tubercles in distant organs, but the widespread dissemination of acute miliary tubercles is not reproduced. Nevertheless these nodules, which consist of a calcified center surrounded by a fibrous capsule, show that healing miliary tubercles may undergo calcification. They are readily identified in roentgenograms of the organs made after death.

When small nodules of uniform size with opacity suggesting calcification are uniformly scattered throughout a chest plate, healed miliary tuberculosis suggests itself and this diagnosis has been made in several instances. Conclusive evidence in favor of this view has been lacking and there has been much difference of opinion concerning the interpretation of these plates.

Widespread dissemination of calcified nodules within the lung substance may be the result of disseminated tuberculous bronchopneumonia which, occurring in childhood, has undergone complete healing. A roentgenogram of a lung in a published instance shows[1] almost uniform distribution of small spherical calcified nodules; but extensive calcified lesions in the bronchial lymph-nodes and absence of healed tubercles in abdominal organs indicate that the individual has survived disseminated pulmonary rather than acute miliary tuberculosis. Nevertheless there is no good reason to doubt that lesions of this type are tuberculous in origin, for other varieties of calcification which are found at autopsy within the lung would not produce the same appearance in a roentgen-ray plate.

Phleboliths, bronchioliths or calcified plates within the pleura do not occur in forms which might suggest miliary tubercles in an *x*-ray plate. There is no pulmonary parasite which with calcification might produce nodular spots. Metastatic calcification has been vaguely suggested. Virchow first described this condition in association with destructive lesions of bone which presumably liberate calcium salts and bring about an over-saturation of the blood. Calcium deposit tends to occur in those tissues where carbon dioxide content is least, namely, in the endocardium of the left side of the heart and in the intima of the pulmonary veins (Wells).[2] Diffuse calcification which affects the alveolar walls of the lung occurs in the form of minute platelets, rods, and scales. There is no probability that a roentgen-ray plate made during life would suggest miliary tuberculosis in these cases.

Though recovery from acute miliary tuberculosis is possible and might result in the formation of calcified nodules within the lungs, proof of these events is difficult to obtain during life. A considerable interval following symptoms suggesting acute miliary tuberculosis would support a diagnosis of healed miliary tuberculosis but in most instances in which disseminated miliary tuberculosis has pursued a chronic course the symptoms have not been characteristic. Roentgenograms made repeatedly during the course of miliary tuberculosis might furnish evidence of recovery with calcification of the nodules. Complete disappearance of tubercles has been described in one instance, tubercles being recognized in the first plate and absent in one made subsequently, but although it is not inconceivable that disseminated tubercles might undergo resolution, there is no evidence which will establish this opinion.

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[1] *Arch. der Heilkunde*, 1860, i, 289.

[2] *Deutsch. Arch. f. klin.* Med., 1873, xii, 277.

[3] *Bull. Ayer Clin. Lab.*, 1906, vol. i.

[1] *Am. Rev. Tuberc.*, 1920, iv, 629.

[2] *Arch. Int. Med.*, 1915, xv, 574.

In rare instances recovery from acute miliary tuberculosis occurs and tubercles with or without calcification doubtless cast shadows visible in a chest plate. With the difficulties in mind a diagnosis of healed miliary tuberculosis is possible.

Eugene L. Opie, M.D.

CARE IN PREPARATION OF MEDICAL PAPERS

During the past few months the editor of this Journal has been at some pains to verify the references in bibliographies presented with papers for publication. We have been astonished to find mistakes in 10 to 20 per cent of the references, and in some lists a very much higher percentage of error.

Examination of reference lists published in recent numbers of prominent medical journals shows that carelessness in preparation of medical bibliographies is by no means confined to contributors to The American Journal of Roentgenology and Radium Therapy. For instance, in a recent number of a well-known journal a bibliography of eleven references is appended to one of the articles. Only three of these references are in all respects correct. In five, the title is wrongly quoted; in two, the year of publication is incorrectly stated; and in three, the pages referred to are wrong.

It has been our experience more than once to fail to find an article because of incorrect data in some writer's reference list. Sometimes the author's name or initials are incorrect; the year, volume or page is wrong, and even the name of the journal may not be correctly given.

The following is a quotation from an editorial on this subject in the *Boston Medical and Surgical Journal,* June 28, 1923:

"A very few of the American medical publications verify such references and these are to be thanked for the hours of labor and careful search they have spared other investigators. In a recent extensive bulletin no less than eight references out of twenty-eight were wrong, two authors' names were spelled incorrectly and two articles were quoted that had no reference whatsoever to the text of the author's paper."

It is an imposition upon readers to present to them a list of references to the literature of a subject, only to have them discover after an annoying search that many of the references are incorrect, that some of the articles cannot be found, and that others have no bearing upon the subject.

Every author should either himself verify all his references or have them verified by a competent person. In the larger cities someone can usually be found in the medical library who will perform this work. If a writer has no one at hand upon whom he can rely, we shall be pleased, upon request, to furnish the name of someone who is willing and competent to do such work.

It is with great regret that we announce the death at Rochester, Minn., of Dr. R. Walter Mills of St. Louis, Mo., on February 16, 1924.

An account of his life will be published in the next issue of the Journal.

Subscribers to The American Journal of Roentgenology and Radium Therapy *visiting New York City, are invited to make the office of* The Journal *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

NEW ROENTGEN SOCIETIES ORGANIZED

THE CLEVELAND RADIOLOGICAL SOCIETY has been organized with the following officers: President, Dr. G. F. Thomas; Vice-President, Dr. E. F. Freedman; Secretary-Treasurer, Dr. J. D. Osmond.

The meetings are held at dinner, on the second Monday evening of each month.

THE MILWAUKEE COUNTY ROENTGEN SOCIETY was organized on February 1, 1924. Its object is not only to emphasize roentgenology as a specialty, but to promote it by educational propaganda and closer relationship with the entire medical profession.

The following officers were elected: President, Dr. F. W. Mackoy; Vice-President, Dr. H. B. Podlaski; Secretary-Treasurer, Dr. C. W. Geyer.

The society meets on the first Friday of each month.

ROENTGENOLOGY IN OBSTETRICS

The Society of Obstetrics and Gynecology of Paris, on November 12, 1923, upon motion of M. Le Lorier, unanimously passed the following resolution:

> "The Society of Obstetrics and Gynecology of Paris regret the absence of a laboratory for obstetrical radiology in a teaching and research center such as Paris.
>
> "Considering the service which obstetrical radiology can now render and the still more valuable service which it will render in the future,
>
> "Resolved: That there be created in one of the hospitals of Paris, provided with a maternity service, a central laboratory of radiology, specializing in obstetrical examinations, provided with the necessary space, material and personnel;
>
> "And further resolved, that this resolution be transmitted to the obstetrical societies of the hospitals with a view to community effort in carrying out this resolution."

Dr. James T. Case, commenting upon the above resolution, writes: "It would not be a bad idea if in some of the large cities of this country, similar action might be initiated."

RADIUM SOCIETY MEETING

The American Radium Society will hold its Ninth Annual meeting at the Drake Hotel, Chicago, June 9 and 10, 1924. Those who expect to attend the American Medical Association meetings at the same time, will find this one of the most up-to-date and conveniently located hotels in Chicago, especially in relation to exhibits and scientific sessions. Reservations can be made immediately through the Arrangement Committee of the American Radium Society by addressing Dr. Henry Schmitz, 25 East Washington St., Chicago.

The scientific sessions of the American Radium Society will be held at the Drake Hotel. Further information will be announced when the arrangements have been fully completed.

Contributions for the program should be forwarded at once to G. E. Pfahler, M.D., Chairman of the Program Committee, 1321 Spruce St., Philadelphia, Pa.

REQUEST FOR BIBLIOGRAPHIES

Dr. J. Wetterer of Mannheim, Germany, has been commissioned by *Strahlentherapie* to edit a special volume entitled "Radiotherapy in Foreign Countries." Dr. Wetterer proposes not only to enumerate the contents of all articles and books which appeared between 1922 and 1924 on roentgenology and radium therapy, in countries other than Germany, but to describe the progress of technique and apparatus.

In order to accomplish this purpose he requests that each author send to him as soon as possible a complete bibliography of his own articles published since 1922, together with a concise abstract of each article. The work is to be published not only in the projected volume of *Strahlentherapie* but also in a new edition of Dr. Wetterer's "Handbuch der Röntgen und Radiumtherapie."

The work must be completed at an early date, and haste is urged in sending the data. Address Dr. J. Wetterer, Mannheim 02, 1 (Germany).

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

THE CONTOUR OF THE ISOLATED ENTIRE DUODENUM

BY J. BUCKSTEIN, M.D.

NEW YORK CITY

THE method employed as routine for the roentgenographic visualization of the duodenum depends upon the expulsive mechanism of the stomach. The stomach must first be filled with a radiopaque mixture. Only small amounts are ejected into the small intestine, because of the controlling function of the pyloric sphincter. As each small amount of the mixture enters the duodenum, it is rapidly hurried on its way by means of the normal intestinal peristalsis. As the result, the filling of the entire duodenal curve, with the exception of the cap, occurs in fragmentary fashion. Only a general impression of the sweep of the duodenal curve is ordinarily obtainable. An intimate knowledge of the radiographic structure of the duodenum, beyond the first portion, is very frequently impossible. Moreover, the barium-filled stomach may over-lie a portion of the transverse duodenum and prevent a proper visualization of this region.

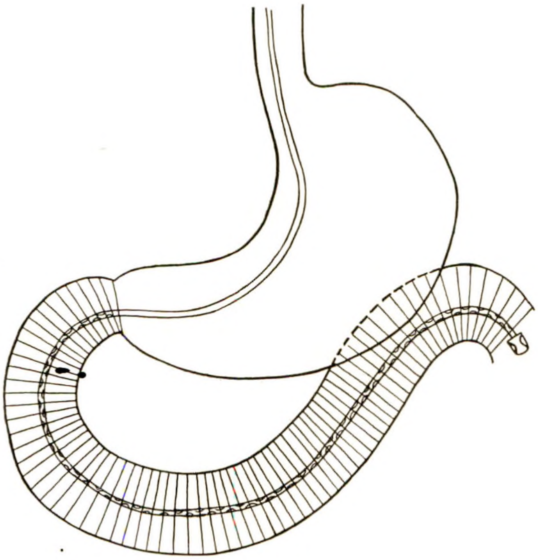

Fig. 1.

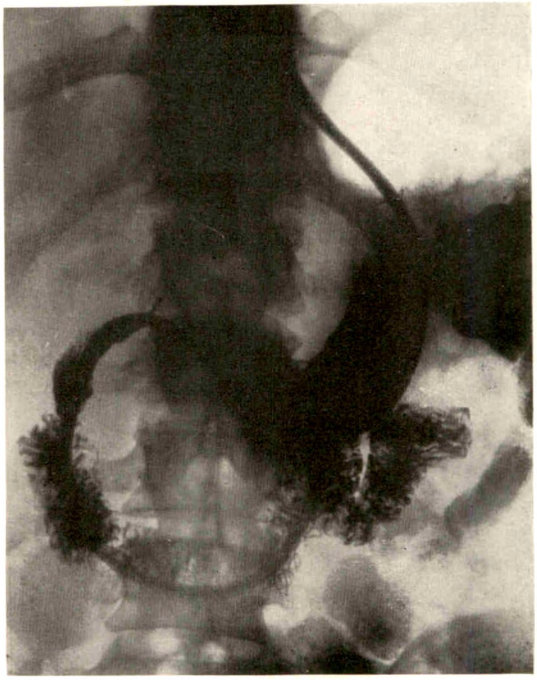

Fig. 2.

The isolated entire duodenum may be filled in homogeneous fashion by means of the following simple procedure: An intestinal tube 45 in. long is constructed, so that the distal 12 in. of rubber has numerous small perforations. The tube is swallowed by the patient until the metal end reaches the duodenojejunal junction. This is determined roentgenoscopically. About 40 c.c. of a barium suspension is injected through the proximal end. The mixture, on escaping through the perforations of the distal end of the tube, will completely fill the intestinal area subjected to this flow. All this region will be filled at practically one and the same time. A roentgenogram is taken immediately upon completing the injection.

The method is of value for the following purposes:

1. A study of the variations in the size of the duodenal curve as compared with variations in body habitus.

2. To determine enlargement of the duodenal curve, where a tumor of the head of the pancreas is suspected.

3. To demonstrate the intimate connection with the lumen of the intestine of a suspected diverticulum.

4. For the more accurate visualization of distortions in contour, due to extra-duodenal pathology.

5. For the detection of intrinsic changes due to ulceration or infiltration, in regions beyond the first portion of the duodenum.

A DIAGNOSTIC NEEDLE AND SPECIMEN OBTAINER

BY JOSEPH MUIR, M.D.

NEW YORK CITY

THIS instrument is designed to secure tissue specimens for pathological examination from regions not accessible by the ordinary open methods of approach. By its use a sufficiently inclusive tissue plug can be removed from any depth within its length with a minimum of traumatism, and the extent of a growth, indicated by roentgen-ray or other findings can be checked up by spacing a number of stabs of varying depths over the suspected area. An important feature of the instrument is that its construction precludes the possibility of malignant tissue-fragments being carried into healthy tissue.

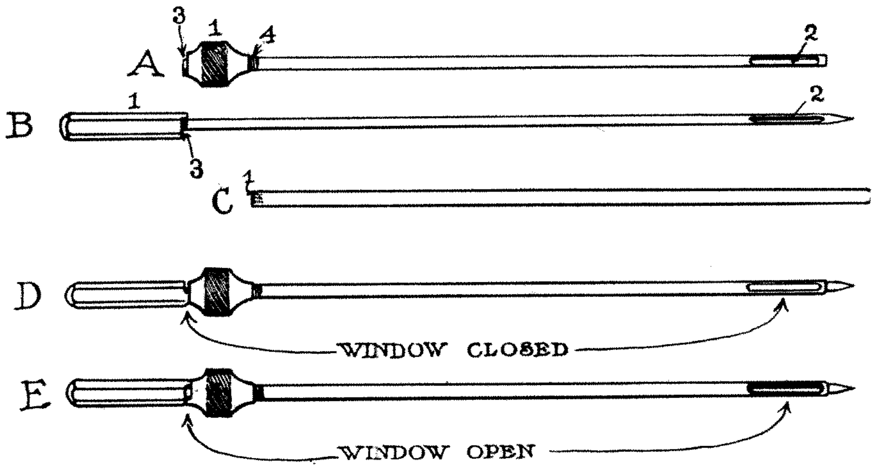

FIGURE ONE (1)

DESCRIPTION OF INSTRUMENT

The instrument consists, first, of the sheath A, having a knurled collar (1) by which the instrument is grasped when in use at its outer end, and a window (2) ¾ in. long, at its inner end. Into this sheath fits the stabbing needle B, with the handle (1) at its outer end and a deep groove (2) at its inner end. This groove is the essential portion of the instrument and corresponds exactly with the window in the sheath when the needle is fully within the sheath. The cross section of the groove is such that whenever the needle is rotated within the sheath in clockwise direction, its upper edge acts as a knife, cutting into whatever tissue may have been forced through the window into the groove, and on further rotation, this cutting edge passes beneath the lower edge of the window, the ungrooved portion of that part of the needle obturating the window. Thus, the tissue plug obtained remains within the groove and completely obtected by the wall of the sheath.

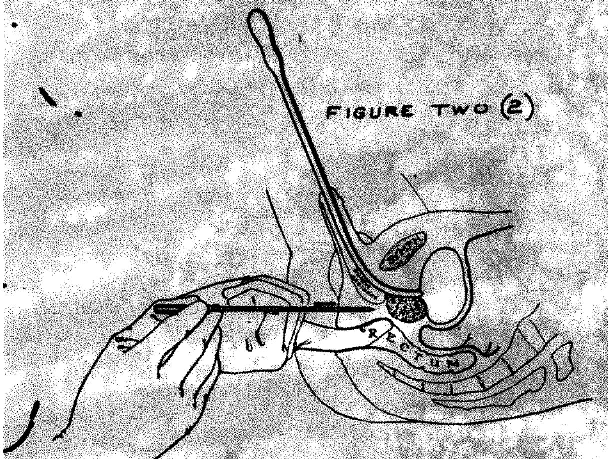
FIGURE TWO (2)

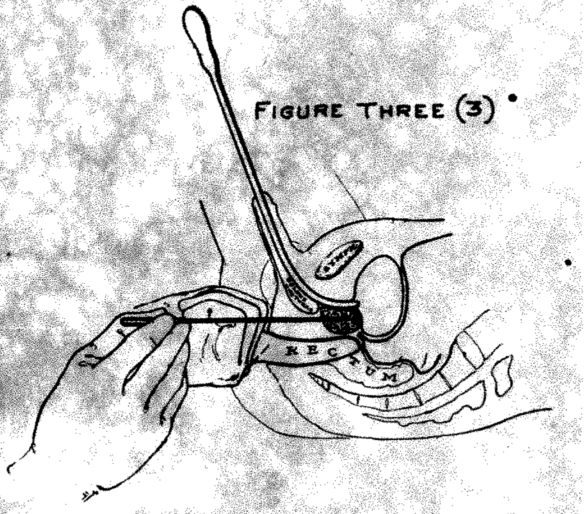
FIGURE THREE (3)

Notches (3) cut into adjoining ends of A-1 and B-1 indicate the relative position of groove and of window and, contingently, the amount of twist required to complete the cutting turn of the needle.

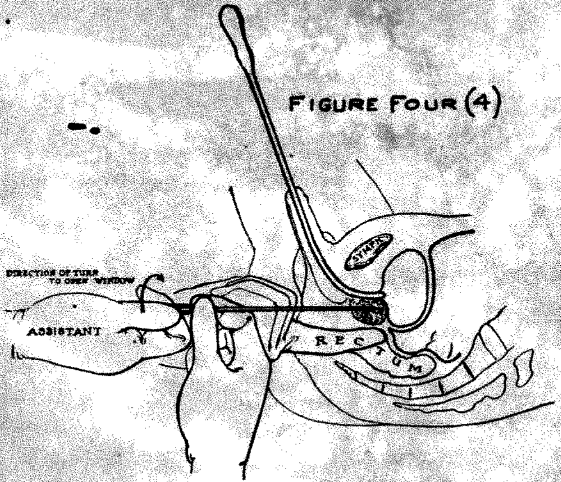
FIGURE FOUR (4)

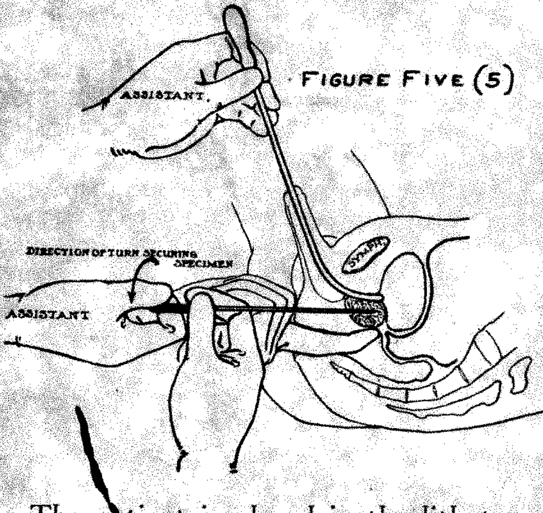
FIGURE FIVE (5)

A third part of the instrument is the case C, with an inner screw-thread (1) which corresponds to the screw-thread A 4, on the head of the sheath. This case not only protects the point of the needle but also permits the instrument to be carried about in a sterile condition, and in the event of only one specimen having been secured, the latter may be carried to the laboratory without removal from the groove.

The following description concerns the use of the instrument in suspected malignancy of the prostate.

The patient is placed in the lithotomy position and the perineum rendered surgically clean. With a metal catheter in the urethra, the operator explores the affected prostate with the finger in recto. The proper spot of entry, between anus and bulbus urethrae, having been chosen, the sterilized instrument with the window closed, as shown in D, is pushed inward, the finger tip in recto guiding the progress of the needle-point (Fig. 2). The inward progress of the needle is continued until the proper spot has been reached (Fig. 3). As soon as this point has been reached, the operator makes sure that the window faces the tip of the finger. This can be easily determined by the position of the notches A 3 and B 3. At this juncture the operator takes a firm hold of the head of the sheath to prevent it from turning and an assistant grasps the head of the needle (Fig. 4), the operator's finger in recto not making any undue pressure against the instrument.

In the next step the assistant turns the needle in the sheath as far as the notch will permit, thus opening the window to the groove as shown in E, and the operator gently pushes the tip of his finger in recto against the instrument, the assistant, meanwhile making counterpressure by taking hold of the metal catheter (Fig. 5). This procedure assists in forcing tissue into the groove.

Finally, with hands and instruments in this position, the assistant twists the needle back to the position D. The tissue plug is now contained within the groove and protected by the sheath, and the whole instrument is withdrawn.

Undoubtedly, many a man has, in the contemplation of x-ray apparatus for his office, given serious thought to the type of equipment which he wished to install, and has assumed that with a modern laboratory, he would be in a position to render the best of service. Such a misguided individual learns all too soon that a very large part of the battle lies within himself, and if his own knowledge is deficient, the finest equipment in the world will not make him a roentgenologist. It is important, therefore, that those who contemplate any indulgence in this field should not underestimate the task that confronts them or consider lightly the responsibilities it entails.

In addition to becoming familiar with the electro-physics of x-ray laboratory equipment, its practical application in his chosen field and the dangers which surround it if improperly used, one should realize that the real practice of roentgenology begins when the x-ray picture or radiogram, has been produced. It is quite impossible for such an image to be of value unless the roentgenologist is thoroughly familiar with the anatomy, physiology and pathology of the field under examination; and even these qualifications are not adequate unless backed up by practical clinical experience. From DENTAL AND ORAL RADIOGRAPHY by JAMES DAVID McCOY, M.S., D.D.S., F.A.C.D.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Radiography and Radio-Therapeutics. By Robert Knox, M.D. C.M. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), Consulting Radiologist, Great Northern Central Hospital, London; Hon. Radiographer, King's College Hospital, London; Director, Electrical and Radio-Therapeutic Department, Cancer Hospital, London; Captain R.A.M.C. (T.) 4th London General Hospital (In Charge of *X*-ray Department). Cloth. Price $12.50. 429 pages, with 93 plates (1 in color) and 337 illustrations. Part I, Radiography, 4th Ed. Macmillan, New York, 1924.

The Fourth Edition of Radiography more than ever establishes it as the standard English text and reference book on this subject. Some additions have been made since the third edition which bring the work well abreast of the advances in both technique and diagnosis. The additions are found particularly in the chapters on the Liver, Gall-Bladder and Urinary tract, but minor additions will be found throughout the volume. Among the latter are descriptions of the Coolidge Portable *X*-ray Outfit, The New Portable *X*-ray Outfit for Military use, such as was used in the U. S. Army during the World War, a complete description of the Potter-Bucky diaphragm, and a brief description of the Lilienfeld tube.

Pruritus of the Perineum (Pruritus Ani, Vulvae and Scroti). By Joseph Franklin Montague, M.D. of the Rectal Clinic, University and Bellevue Hospital Medical College; Fellow American Proctologic Society and New York Pathological Society. Foreword by George David Stewart, M.D., President of the New York Academy of Medicine. Cloth. Price $3.50. 199 pages, with 37 illustrations. Paul B. Hoeber, Inc., New York, 1924.

Dr. Stewart says in the foreword: "Dr. Montague's monograph is a methodical, careful survey of the subject from all points of view, physiological, anatomical, pathological, etc." The book does, in fact, cover every phase of the subject, and is based not on a study of the literature alone but on careful experimental and clinical observation.

Under Treatment the author describes palliative and curative measures and under the latter he gives consideration to roentgenotherapy, radium therapy, ionic medication and surgery. Several operations for pruritus ani are described, including the author's own method.

There is appended a very complete bibliography.

Pierre Curie. By Marie Curie. Price $2.25. Contains 242 pages. The Macmillan Co., New York, 1923.

This is one of the most attractive biographies that it has been our lot to read for many a day. A woman, a great scientist herself, tells in simple language the life story of her husband, Pierre Curie.

The vivid interest of the story lies not so much in a recital of the important achievements of a great scientist as in an intimate portrayal of the high ideals of a lofty character. How Pierre Curie literally dedicated his life to science; how, in spite of poverty and hardship, he adhered to his altruistic ideals; how he refused a professorship at Geneva which would have insured an easier life, but which he believed would interfere with his scientific work; how he also refused to allow his name to be presented for the *Palmes academiques* and later refused the decoration of the Legion d'Honneur; how he had the confidence of Berthelot, Lord Kelvin, and other great men of his time; how he was finally enabled to pursue his scientific work without worry by appointment as professor in the Sorbonne and by the granting of the Nobel prize; and how he had scarcely adjusted himself to this new outlook when he was suddenly killed at the age of only forty-six years—all of this, and in addition the story of a beautiful home life, is told interestingly and unaffectedly by the comrade who shared both his home and his work.

Pierre Curie's attitude toward decorations arose from his sincere belief that they were distinctly harmful and "that they can degrade the worthiest aim of man, which is, work for the pure love of it."

Not the least attractive part of the book is Marie Curie's own autobiography. Her story of the discovery of radium is full of interest and must offer great inspiration to those who are carrying on scientific investigation under adverse circumstances. The following quotations are taken from this fascinating account of a great discovery:

"I had decided on a theme for my doctorate. My attention had been drawn to the interesting experiments of Henri Becquerel on the salts of the rare metal uranium. Becquerel had shown that by placing some uranium salt on a photographic plate, covered with black paper, the plate would be affected as if light had fallen on it. The effect is produced by special rays which are emitted by the uranium salt and are different from ordinary luminous rays as they can pass through black paper. Becquerel also showed that these rays can discharge an electroscope. He at first thought that the uranium rays were produced as a result of exposing the uranium salt to light, but experiment showed that salts kept for several months in the dark continued the peculiar rays. . . . I then thought to find out if there were other substances possessing this remarkable property of uranium, and soon found that substances containing thorium behaved in a similar way, and that this behavior depended similarly on an atomic property of thorium. I was now about to undertake a detailed study of the uranium and thorium rays when I discovered a new interesting fact. I had occasion to examine a certain number of minerals. A few of them showed activity; they were those containing either uranium or thorium. The activity of these minerals would have had nothing astonishing about it, if it had been in proportion to the quantities of uranium or thorium contained in them. But it was not so. Some of these minerals revealed an activity three or four times greater than that of uranium. I verified this surprising fact carefully, and could not doubt its truth. Speculating about the reason for this, there seemed to be but one explanation. There must be, I thought, some unknown substance, very active, in these minerals. My husband agreed with me and I urged that we search at once for this hypothetical substance, thinking that, with joined efforts, a result would be quickly obtained. Neither of us could foresee that in beginning this work we were to enter the path of a new science which we should follow for all our future."

The story continues with an account of the discovery of polonium and finally of radium, and then goes on to tell of four years of arduous labor in an old shed until she and her husband were finally able to isolate radium and to determine its atomic weight.

American readers of this book will feel a real sense of gratitude to Mrs. William Brown Meloney who prevailed upon Mme. Curie to write it.

BOOKS RECEIVED

A System of Surgery. 2nd Ed. By C. C. Choyce, C.M.G., C.B.E., B.Sc., M.D., F.R.C.S., and J. Martin Beattie, M.A., M.D., C.M. Price $35.00. 3 Vols. 3300 pages, with 50 color plates, 98 half-tone plates and 910 figures. New York: Paul B. Hoeber, Inc., 1923.

Lectures on Endocrinology. By Walter Timme, M.D. Price $1.50. 133 pages, with 27 illustrations. New York: Paul B. Hoeber, Inc., 1924.

Pruritus of the Perineum. By Joseph F. Montague, M.D. Cloth. Price $3.50. 199 pages, with 37 illustrations. Paul B. Hoeber, Inc., New York, 1923.

X-Rays: Their Origin, Dosage and Practical Application. By W. E. Schall, B. C. Lond., F. Inst. P. 119 pages. Bristol: John Wright & Sons, Ltd., 1923.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

Gann, Dewell. The review of forty consecutive cases of carcinoma of the cervix. *Urol. & Cutan. Rev.*, Sept., 1923, xxvii, 563.

These cases were divided into: Operable, in which the disease was limited to the cervix; inoperable, which involved the parametria; and border-line, in which there was bladder and rectal involvement.

The youngest case was thirty, the oldest sixty-eight; the approximate average being fifty-one; 24 were between fifty and sixty years old, all were married or widowed; 38 had given birth to children—from one to eleven, an average of four; 15 were treated surgically, 17 by radium, 1 by radium and surgery, 3 by radium and roentgen ray, 1 by Percy cautery, 2 by cautery, 2 by cautery preceding the application of radium.

The roentgen treatment here referred to was the ordinary deep therapy with Coolidge tube and not the high voltage machine now in use.

All the cases were treated between July 8, 1920, and July 31, 1922.

Of the 15 surgical cases 7 are living and apparently well, 2 are dead, and 6 not heard from. Of the 7 living, 2 had Wertheims and 1 a high amputation of the cervix.

Of the 4 traced living cases of radium, all are apparently well. Of the 2 known dead, 1 had a Wertheim and the other died as a result of a malarial hematuria four months after a panhysterectomy.

Of the 18 inoperable cases, 10 were treated with radium, 2 with radium and roentgen ray, with cautery preceding radium, 2 with cautery alone, 1 with Percy cautery, and 1 refused treatment.

Twelve are apparently well. Six have not been heard from.

Of the 5 borderline cases, 1 had a Wertheim, 1 a panhysterectomy, 2 radium, 1 radium and roentgen ray. The Wertheim is living two and one-half years after operation. The panhysterectomy has not been heard from. Of the 2 radium cases, 1 is alive, and 1 dead from diabetes mellitus. The case treated by roentgen ray and radium is alive two years after treatment.

Goin, Lowell S. The Holfelder technique in deep therapy. *J. Radiol.*, Oct., 1923, iv, 354.

The basis of deep therapy is founded upon the biological experience that different cell-forms exhibit different sensibilities to the roentgen-ray. Different cell-sensibilities are manifested to different degrees of hardness of roentgen ray. These differences in sensibility depend upon the production of a homogeneous field.

Heterogeneity if greater than the sensibility between the normal and pathological cells, will prevent success. The law of effective action may be stated: $I \times T \times Sp > I \times T \times Sn$, in which I is the intensity of radiation, T is the time of application, Sp is the degree of sensibility of the pathological cells, and Sn is that of the normal cells.

Homogeneity must be both qualitative and quantitative. For practical purposes rays are homogeneous, if their intensities do not vary more than 5 per cent.

Holfelder has devised an instrument by which actual homogeneity may be attained and smaller fields may be used, and the cones of rays more accurately directed so as to avoid important organs which should not be radiated. It has been found that only with 3, 5 or other odd numbers of courses can a homogeneous radiation be made. The percentage dose is the amount of radiation 10 cm. in the depth in relation to the surface dose, and may be expressed in terms of percentage by the formula:

$$\frac{1^1 \times 100}{1^2} = \text{P.D.D.}$$

1^1 being the discharge time of the iontoquantimeter with given factors, 1^2 the discharge time with the same factors in a 10 cm. depth. Holfelder believes that the varying degrees of hardness produced by increasing the thickness of an already heavy filter are not important biologically, and in using the field selector the various percentage depth doses are produced by varying the size of the field and the target-skin distance, the voltage and filtration remaining constant.

The field selector is made from truncated triangles of photographically tinted celluloid and an illuminated glass plate on which is painted a series of geometrical figures of varying density and of the same color as the trial fields. The tint of the trial fields goes from dark to light from above downward, in carefully calculated percentages, on the glass plate. There are a great number of figures, squares, triangles, points and circles. Each square, each triangle, each point and each circle is of exactly the same tint, but the circles are much darker than the points, the points are darker than the squares and the triangles are the lightest of all.

To apply this, a strip of block tin is molded to the cross-section of the body at the proper level and then by the proper means the tumor is located within the block tin outline of the cross section. Then the trial fields are selected by trial and error, crossing the parts to be irradiated, and avoiding those not to be rayed.

Homogeneity in the radiated area is a prime essential.

Better homogeneity is obtained by using three or five fields than by the use of two or four.

The use of small fields is necessary for the treatment of disease in certain regions.

The Holfelder field selector offers a means of attaining better homogeneity, permits of accurate cross-firing and enables the ray-cones to be directed in such a manner as to avoid the radiation of important uninvolved organs. It therefore offers the most accurate and scientific means of applying roentgen ray for deep therapy.

Gross, O. Roentgen diagnosis of pancreatic diseases. *Klin. Wchnschr.*, 1923, ii, 1346.

According to Pueschel, pancreatic processes which cause a diminution of space will be characterized by:

1. Formation of a small high gastric shadow.
2. Bulging of lesser curvature.
3. Formation of defect, simulating gastric carcinoma.
4. Engorgement and displacement of the duodenum.
5. Compression of transverse colon.

The larger the pancreatic tumor the more marked will be these symptoms. It is especially marked in cysts and pseudo-cysts.

The first pancreatic cyst reported was that found by Schlesinger. The author, in his own case, did not find the gastric shadow diminished and displaced upward, and toward the left, but downward, with the duodenum. It twined around the cyst with the duodenum, like a thin rubber tube. The aboral part of the stomach was well demonstrable. An ectasis had not yet formed because the case had developed only a few months prior as the result of trauma which had occasioned a pseudo-cyst.

Harris, D. J. Some observations on the behaviour of lymphosarcomata under radium treatment. *Practitioner*, Oct., 1923, cxi, 291.

Three cases of lymphosarcomata occurring within the last twelve months, are reported, in which radium was used with apparent recovery. A recurrence, with resistance of the new growth to the action of radium, with speedy death, followed.

In the first case, the introduction of radium on one side produced unmistakable softening and diminution, not only on that side but on the other side also. In each case the growths, after disappearing almost completely, recurred and grew more rapidly than before.

Upon what lines is the explanation to be sought? The theory must explain the disappearance of sarcomatous lesions at a distance from the site of radiation. It must explain the rapid recrudescence, and the ineffectiveness of repeating the radium.

Loeper and Tonnet reported that as a result of radiation of cancerous tumors they found:

1. An increase in the total protein in the serum mainly affecting the globulin.
2. An increase in the aminoacids in the serum.
3. An increase in the lipoids and protein sugar in the serum.

These blood changes are not due to destruction of leucocytes, but to destruction of the cancer cells.

To correlate the clinical observations we conceive that the first effect of radiation is to kill a few cells in the immediate vicinity of the tubes; that these cells are attacked by the tissue proteolytic ferments; that the products of the action of these ferments act as antigens which stimulate into activity the defensive resources of the body to produce coagulins and lysins; that the effect of these substances is not confined to the site of radiation, causing the disappearance of the growth there, but extends to more remote deposits and influences these also.

The practical question, however, concerns the fate of these antibodies. How long do they exist in the blood? The fact that the growth persists suggests that they have only a transient existence. The fact (if established as such) that the recurrence is more rapid than the original process, and that the re-insertion of radium, after an interval of a month or more seems comparatively ineffective, suggests that not only have the coagulins and lysins disappeared from the blood by that time, but that prior to their disappearance they have caused the production of anti-coagulins and anti-lysins. If that is indeed so, the moral is that the repetition of radiation must be carried out at short intervals of less than a month, in order to anticipate the completion of the cycle just referred to.

Gyoergy, P., and Gottlieb, K. Intensification of radiation therapy in rachitis by per os administration of eosin. *Klin. Wchnschr.*, 1923, ii, 1302.

In treating rachitis with ultraviolet rays the results were improved by giving the children 9.1 gm. of eosin crystal (the bluish

Hoechst preparation) with 0.2 gm. cane sugar by mouth. The results were verified by series of roentgenograms and blood tests.

Hawes, John B. Progress in pulmonary diseases. *Boston M. & S. J.*, Nov. 1, 1923, clxxxix, 635.

P. H. Ringer is quoted as saying that the presence of tuberculosis is based upon five points, the second is roentgenologic, which as the sole evidence of active tuberculosis should not be relied on.

F. S. Bissell says that the matter should be determined by the clinical evidence, and that the conservative roentgenologist will not venture a prognosis in a given case. The negative roentgenologic report has not been given the high place it deserves. The diagnosis of pulmonary tuberculosis should not be made in the face of repeated negative roentgen-ray findings.

Hodges, Fred M. Pericarditis with effusion. *J. Radiol.*, Oct., 1923, iv, 351.

Williamson states that, in pericarditis, with effusion the fluid accumulates first in the costodiaphragmatic angle. This pushes down the left lobe of the liver.

The pericardial rub may persist in fairly large effusion.

The roentgen ray has its greatest usefulness when the effusion exceeds from 150 to 200 c.c. in showing approximately the amount of fluid present and the best location for paracentesis. At times, owing to consolidation in the lung and no to-and-fro friction sound, a diagnosis without the roentgen ray is practically impossible.

Holmes has shown that when the heart is suspended in solutions with a specific gravity between 1.012 and 1.020, its outline cannot be made out by the roentgen ray. He found an absence of pulsation on roentgenoscopic examination about as frequently in markedly dilated hearts as when there was a large effusion. He was unable to see the outline of the heart within the pericardium in any case.

In 16 cases studied there were 200 or more c.c. present, and in 10 of these the roentgen ray showed definite indications of fluid within the pericardium.

In these findings were: (1) A general increase in the width of the cardiac outline; (2) a widening of the mediastinal shadow, which changed with change in position of the patient; (3) a straightening out of the curves of the left border of the heart; (4) the absence of, or weak cardiac pulsations noted, on the roentgenoscopic screen; (5) a change in the space formed by the diaphragm, spine and posterior border of the heart; (6) a bulging of the heart shadow upward and to the left; (7) extension of the mediastinal borders as more or less straight lines up to the clavicle; and (8) in some of the acute, fairly large effusions, a hazy, more dense appearance to the lung shadow about opposite the angle of the left scapula.

Death is sometimes due to pressure on the auricles. Paracentesis pericardii often gives marked relief.

Montanari, A. Indications and contraindications to roentgen therapy in uterine fibromata. *Radiol. Med.*, 1923, x, 458.

Indications and contraindications in uterine fibroma are based first on the patient's general state; second on the character of the tumor, size, number, location, relations, state of tumor, structure and degeneration; third, concomitant physiological or pathological state of the uterus or other organs, pregnancy, malignancy and concomitant tumors or affections of other organs; fourth, data and dangers relating to these states.

It is indispensable to make accurate diagnosis before starting radiotherapy. The same is true in surgical intervention, which must be resorted to in doubtful cases. Patients under forty years of age suffering from fibroma must not be radiated, because, in the present state of our apparatus and technique, no security can be given of influencing the tumor without injuring the ovaries. Around forty those preferably who are near the menopause may be treated by the rays. Those having reached the menopause may be radiated, but if success is not rapid and complete, they must be passed on to the surgeon. Fibromata of large size passing beyond the umbilicus can be radiated especially with the aim of a partial result and reduction.

The best results are seen in small and medium tumors. However, this does not apply always. One cannot deny the possibility of cures from conservative surgery (myomectomy). The number of fibromata, if not excessive, is not of very great importance, because they generally are in direct connection with the entire fibromatous mass.

Subserous fibromata of the pedunculated type and the submucous, and those located in the ligaments, must be left to the surgeon. The interstitial belong to the roentgenologist.

The intermediary types may derive more or less benefit from radiation according as their characteristics approach one of the two latter types. In incarcerated compressed fibromata roentgenotherapy may be tried if local and general disturbances do not call for urgent intervention. The tumors most recently developed are the ones that most easily yield to ray treatment. It has not as yet been established beyond doubt whether tumors of muscular or of fibrous prevalence in their structure respond more readily. It is certain however, that in some instances pure myomata as well as sclerotic fibromata are little influenced; and the least influenced are the myoadenomata. The common degenerated fibroma will be left to the surgeon: first—for prudence (cystic degeneration) and from utilitarian reasons (ischemic degeneration); also from necessity (septic and calcareous degeneration). In cases where there is certainty or suspicion of concomitant existence of an epithelioma, roentgen treatment must not be given.

Radiation may be used where sarcomatous degeneration is certain or suspected, but the technique adapted for these tumors must be observed. These cases, when referred to the surgeon, always give rise to dissemination and the result cannot always be predicted.

Pregnancy is always a contraindication to roentgen treatment. Where laparotomy is made for some reason and a fibroma is detected it goes without saying that the tumor should be removed in the same operation. In any pathological state which renders operation especially dangerous, the insistence upon roentgen treatment is ill-advised.

On the whole it is impossible entirely to avoid roentgen dermatatis or adhesions, or sclerosis of the connective tissue, ectasis, or vascular hyperplasia, psychic disturbances in consequence of the menopause, or disturbances in the body resistance in regard to operations and later infections.

Another indication is formed by the patient's fear of operation and his needs, from a social standpoint, of rapid recovery.

Montanari, A. Perivaterian duodenal diverticulum. *Radiol. med.*, 1923, x, 445.

A male patient, aged sixty-three, suffered from icterus for five months. For two months he had pain in the epigastric and umbilical regions, which occurred with a certain regularity, and spasmodicity, every eight to ten days, at 10 p.m. It did not radiate to the back. The urine contained some bile pigment. The stools, which had been white, had regained their normal color when he was examined. Appetite and weight were diminished. The previous history was negative. Palpation of the abdomen revealed little that was abnormal, excepting some pain on pressure in the region to the right, and above the umbilicus. The diagnosis of either calculus of the common duct or neoplasm of the head of the pancreas suggested itself. He was operated upon, and a biliary calculus extracted.

The roentgenogram showed no shadow which could be referred either to biliary calculus or to pancreatic disease. The opaque meal showed normal size and shape of the stomach. Peristalsis was normal. When the meal had passed the pylorus and entered the duodenum a circular shadow appeared in the ampulla of Vater, about 2 cm. in diameter. The duodenum appeared normal in size and shape. Pressure in this region caused only slight discomfort. When the patient was examined lying down, the shadow which was circular in the erect position became pear-shaped. It was not homogeneous, but mottled with light spots. After one hour and forty minutes the gastric residue became small, the shadow irregular in outline and the light spaces larger. After three hours the stomach was empty. Barium residue was seen in the duodenum; the abnormal shadow was quite isolated.

Biliary and renal calculi could easily be excluded. The abnormal shadow did not appear during gastric filling but only when the barium passed through the duodenum. The conclusion was that it had some communication with this organ. A diverticulum of a penetrated chronic ulcer was taken into consideration. The case history, however, had revealed no previous disturbances, and gastric roentgenology gave no affirmation. The duodenum was not deformed in its upper part and the cavity under discussion was located in the descending part of the duodenum which is a characteristic site of duodenal diverticula. Two surgeons had expressed the possibility of a dilatation existing in the ampulla of Vater, in consequence of a biliary calculus expelled into the intestine.

A clinical complication of a duodenal diverticulum must be mentioned, namely, chronic pancreatitis.

Morton, Henry H. Temporary suppression of urine following double pyelography. *J. Urol.*, Sept., 1923, x, 261.

The history of the case reported pointed to calculus in the left kidney or ureter. Cystoscopy showed a normal bladder. On the right side a No. 6 catheter passed into the pelvis of the kidney; in the left ureter, about 2 in. from the bladder, obstruction was met. The urine from the right kidney had 4 gr. of urea to the ounce. Phythalein appeared in four minutes. It had no pus nor casts, but a few streptococci. The urine from the left kidney was cloudy, and had no pus, casts or bacteria. There were 2 gr. of urea to the ounce. The radiogram showed a small calculus, 1½ in. from the bladder. The pelvis of each kidney

Almost all cancers, excepting those of the female generative organs, will sometimes show bad results. The most unfavorable relatively are those of the intestinal tract. Prophylactic radiation after amputation of the breast for carcinoma has had varying results, according to technique. Perthes and others, who used high doses, have even seen aggravation from them. Others, such as Anschuetz, who used small doses, have seen improvement and lasting recovery. Isolated carcinoma cells cannot be destroyed even with the tenfold carcinoma dose. Hofbauer saw vulvar carcinoma undergo regression after radiation of the hypophysis, as in direct radiation.

In experiments on mice it was seen that carcinoma was hard to influence where the diseased area was carefully isolated. The effect was better when the surroundings were also touched by the rays. Evidently the action of the roentgen rays is not a direct one, with our therapeutic means. The doses are much too small for that. Doses ten to thirty times as large could be expected to cause cell destruction. The effects of local and general radiation are practically the same. The author thinks that chemical substances arise during radiation, and more abundantly at the focus. If the more distant tissues show little change it is because the chemicals form in a diminishing degree with the diminution of the ray influence. In animal experiments connective tissue and blood changes have been observed. The author thinks that genuine recovery is not effected, or that, at least, it cannot be demonstrated by our present-day means.

Pfahler, G. E. Diseases of the lungs studied by the use of the roentgen ray. *Ann. Clin. Med.*, Nov., 1923, ii, 201.

The roentgen ray plays an important part in the study of diseases of the lungs and its results must be considered with other clinical evidence.

The roentgenoscope permits the study of the movements of the diaphragm and the movements of the various portions of the lung tissue, and the effect of the heart beat upon the surrounding lung tissue. It permits rotation and manipulation, so as to bring the best view and to determine the best point of attack in pulmonary abscess. The operator should remain in the dark room at least fifteen minutes before undertaking this work to enable the retina to become sensitive.

Teleoroentgenograms give the best results both anteriorly and posteriorly. In cases of early tuberculosis stereoscopic films are desirable; preferably anteriorly. A special film should also be made of the apices. In these cases the clavicles should be projected downward so as to leave the apex clear for study and comparison.

In advanced cases the roentgen ray shows, as a rule, more extensive lesions than the physical signs would indicate.

Pneumonia can be recognized in all stages. In the study of pulmonary abscess the roentgen ray is almost a necessity. It is also of great value in the study of pulmonary diseases of children.

Sasso, E. Saffron in roentgenography. *Radiol. med.*, 1923, x, 480.

Prof. R. Namias, Director of the Photographic School, in Milan, working on the basis of the discoveries of Cramer, made in 1921, and the work of Ludwig and Lumière, has found valuable methods to facilitate developing of plates. Saffron, in great dilution, desensibilizes the sensitive layers of the photographic plates, and makes their handling easier. It is a well-known fact that roentgen rays act uniformly on all layers of the emulsion. Saffron makes longer development possible, improves under-exposed plates, and chemical veiling is lessened. The deep developing is perfected, and produces more contrasts in the plates. Details are brought out more clearly. Exposure can be reduced to almost half the time. The reinforcing screen can be used with it.

Schroder, J. Henry. Massive neoplasm of the lung with paralysis of the diaphragm. *N. York M. J.*, Nov. 21, 1923, p. 628.

This patient was fifty-nine years of age. His previous history suggested nothing of interest in connection with his present illness.

He was first examined in November, 1921, and again on April 4, 1922, when a decided increase in the morbid condition was noted. The loss in weight in that period had been about 11 lbs. The affected half of the right lung showed complete dulness on percussion and pronounced bronchial breathing on auscultation, an occasional feverish temperature toward evening, and shortness of breath, quite intense upon slight exertion. The complement fixation test for tuberculosis was negative. The blood examination showed only secondary anemia. The roentgenogram shows a well-circumscribed, deep shadow, quite extensive, apparently in the upper half of the right lung, affecting the upper lobe and part of the middle lobe. Roentgenoscopic examination showed marked contrast in the respiratory expansion of the sound left side and the affected right side. The diagnosis was made of pulmonary tumor, and that it was probably of a carcinomatous character.

The patient says that he coughed only moderately. The surface lymphatic glands were not enlarged. There was very limited chest expansion on the right side and no evidence of pleural exudate.

Stereoscopic lung plates revealed a dense infiltration of the parenchyma of the upper half of the right lung, fusing with clearer lung tissue of the lower part of the lung. The right side of the diaphragm was elevated and immobile. The paralysis can be accounted for by the almost inevitable compression of the phrenic nerve above. The condition of the patient indicated the malignant character of the new growth. Irradiation was undertaken because of the still comparatively good condition of the individual that promised good resistance.

On April 14, 1922, the minimum carcinoma dose of Wintz, that is, 100 per cent of the surface erythema dose of the ultra-hard roentgen ray at 200,000 volts maximum, to the tumor mass in the lung, was administered in one treatment. One large area of entrance in front and one in the back were used, corresponding to the area of lung involved. Seven days later an additional 30 per cent of the carcinoma dose was administered through an available area that had not been exposed during the first irradiation.

The systemic effect of the irradiation was mild. Increased cough and tightness in the chest became evident in twenty-four hours and subsided in the course of a week. The surface irradiation erythema was mild, and with subsidence of systemic reaction, the patient's condition improved visibly. He gained 2½ lb. in ten days, and continued to improve.

On June 6 and 9, 1922, the second dose was administered, with the following difference in technique: in order to obtain the greatest homogeneity of radiation, doses of 100 per cent of Wintz units were administered to the upper portion of the tumor and to the lower portion, including the hilus region, three days apart.

On November 15th, roentgenographic examination showed only a slight increase of density of the shadow on the right as compared with the left.

A re-examination on February 1, 1923, one year after the irradiation, revealed the lung still entirely free from recurrence of tumor and any tendency to fibrosis.

Hines has reported a case of a spindle-celled sarcoma of the lung which was subjected to roentgen irradiation three times in four months. During the last series of treatment respiratory distress developed, and several days later, death occurred. Post-mortem histological examination revealed an extensive fibrosis of the lung. All parts of the lung were consolidated from proliferation of connective tissue in the alveolar walls, with resultant great decrease in air space, which accounts for the dyspnea cyanosis, and death.

SUTHERLAND, GEORGE FRED and MITCHELL, JAMES HERBERT. Effects of treatment of bone lesions in congenital syphilis. *J. Am. M. Ass.*, Nov. 24, 1923, lxxxi, 1752.

Osteochondritis syphilitica is the most common and characteristic bone change in the syphilitic fetus and in the new-born infant.

Various observers have noted this change which varies from 70 per cent to 93.4 per cent. Shipley and his co-workers found in 100 supposedly normal infants 15 with advanced syphilitic osteochondritis, 10 with less marked changes, and 21 with changes strongly suggestive of syphilis.

It is best seen in the fetus or in the infant under three months of age.

In the first stage, the calcified zone between the epiphysis and the diaphysis widens to a breadth of 2 mm., as a white or pink line. In the second stage this may be increased to 4 mm. Necrosis of the bony trabeculae occurs. In the third stage the periosteum and the perichondrium become thickened in the epiphyseal region. Separation of the epiphysis from the diaphysis frequently takes place along the line of necrosis, and pathologic fracture may result.

The bones most commonly affected are, the lower end of the femur, the distal and proximal ends of the tibia, the distal ends of the radius and ulna, the extremities of the metacarpals, the proximal ends of the phalanges, and the proximal ends of the ulna and radius.

There were 18 cases of congenital syphilis of infants. Nine of the infants had symptoms of bone disease.

The usual treatment was from six to eight weekly injections of neoarsphenamin, in doses up to 0.15 gm. intravenously or intramuscularly followed by eight or ten weekly intramuscular injections of mercuric salicylate in oil, in doses from one-fifth to one-third grain. This was followed by a rest from treatment for from three to five weeks, and then a Wassermann test was made and the course was repeated.

The symptoms of bone lesions decreased after the first injection of neoarsphenamin, and usually disappeared within a month.

As the roentgen-ray findings disappear in the absence of treatment, it is difficult to determine whether or not the improvement is more rapid with treatment.

Under this treatment the roentgen-ray picture slowly returned to the normal. The periosteal changes are slower to return to normal. However, within a few weeks the narrow, clear area between the cortex and the periosteum becomes less distinct.

In older children, from three to fifteen years the bone process is more often a periostitis with or without a gummatous osteitis.

In the abstracts of the discussion of this article, Dr. Mitchell says: "The bone changes in rickets are somewhat similar but they do not develop until some months after birth. Therefore, the roentgen-ray examination of the long bones is probably the most valuable method of diagnosis of congenital syphilis at the present time."

Wood, Francis C. Further studies in radiation dosage. *J. Radiol.*, Oct., 1923, iv, 343.

The great need in radiotherapy is the means of accurate dosage.

Some are still treating internal cancer with ten- or fifteen-minute exposures with a filter of 3 mm. Al and an 8-in. gap, but without the slightest idea of the erythema dose of their machine or the effect of the radiation penetrating the deeper tissues. If they accomplish anything, they stimulate rather than inhibit the growth.

Experiments were made in The Crocker Institute of Cancer Research with a commercial machine running at 170,000 volts. This voltage was very carefully determined by a physicist using a 25 cm. sphere spark-gap and the standard potential tables for an instrument of these dimensions. The wave forms and current curves show that the voltage and current were in phase. The only variable was the position of the switch on its axle.

Repeated determinations of human erythema doses with the apparatus thus adjusted have shown that, on an average, 45 minutes with a 40 cm. skin-focus distance, 5 ma. through the tube, ½ mm. of zinc plus 1 mm. of aluminum filter, will give a dose which is just short of an erythema. Forty-eight minutes is a good erythema on sensitive skins, and 50 minutes gives a fairly sharp reaction in ten days on insensitive skins.

The death point of the tumor which was used as a standard (Crocker Fund Tumor, N. 180) was found to be 250 minutes under these conditions, that is, five erythema doses. Scatter was eliminated, the tumor being supported upon thin gauze from any substance which might give secondary rays.

Assuming, therefore, that the tumor is killed without scattering with five erythema doses, it is interesting to observe the effect of some substance whose absorption capacity corresponds approximately to that of human tissue.

With 10 cm. of block paraffin, 10 cm. above the tumor, with a 10 × 10 cm. field, the exposure was 675 minutes. The paraffin absorbs 63 per cent of the ray. These conditions do not apply in human therapy, as the tumor is always in contact, on one or both sides, with substances of low atomic weight which give a large amount of scattered radiation. Experiment demonstrated that the dose under these conditions fell to almost four erythema doses.

This particular tumor is some three and a half to four times as resistant as a human basal-cell carcinoma.

When the tumor tissue was placed between two blocks of paraffin, 10 cm. thick, the rays were allowed to strike the tumor through a 10 × 10 cm. opening, the skin focal distance being 30 cm. and the distance to the tissue 40 cm., the dose was 360 min. instead of 675, thus showing how important a factor the scatter is even through a comparatively small opening. This dose in impossible for human cases since the skin would receive some 20 erythema doses.

When the lead opening was increased to 18 × 18 cm. all the tumor cells were killed at 240 min. exposure, or 8.5 erythema doses to the skin. This is still an unfavorable working condition. If, however, the skin focus is changed to 40 cm. instead of 30 cm., the tumor then being 50 cm. from the anticathode, we get a death point of all the cells in 320 min. with 6.4 erythema doses on the skin.

Thus we see that a much better depth effect is oftained by using a longer skin-focus distance.

We do not yet know whether human intestine or other hollow viscera will stand four erythema doses. Not more than four erythema doses have been given to a deep-seated tumor, that is just two thirds the amount required to kill the mouse tumor, No. 180.

Some very interesting observations with roentgen ray derived from a continuous current of high voltage will be reported later on.

Woodcock, H. M. A modification of Dr. Charles Creighton's view of malignant growths. *J. Roy. Army Med. Corps*, Oct., 1923, xli, 241.

Reasoned imagination based upon considered observation is what is needed to-day in the study of many diseases of whose mode of causation we are still ignorant.

The necessity for a comprehensive knowledge of the biology of tissue cells, if the cancer problem is to be successfully attacked, is now generally recognized. By cell biology is meant the mode of life and especially of nutrition. It is essential to remember that the tissue cells are individual units, specialized homologues of unicellular animals.

Many types of tissue cells are accustomed normally to digest or metabolize blood elements, especially the red blood corpuscles. This function is called hemetaboly, and may be preceded by actual ingestion (hematophagy) of the cells,or it may take place extra-cellularly.

In its beginning, malignancy is rather a biological reaction than a pathological process. The cancer cells may be regarded as recuperated cells, which have acquired a fresh (if spurious) lease of vital activity. The disease results from the effects, both upon the body politic and on themselves, of their excessive and unrestrained multiplication and spread. And the essential factor in the causation of this malignant condition is the independent re-acquirement, by certain individual cells, of the capacity to assimilate the products of hemetaboly entirely for their own use, instead of performing their normal bodily function in this respect; in other words, they have reverted to the condition of free, single cells.

The main emphasis is that normal hemetaboly is not, in general, for the benefit of the cells themselves, but for the body as a whole, and its use for their own growth or multiplication is most stringently controlled. Normal hemetaboly is the key to the understanding of the malignant condition.

Numerous instances are given of cancer cells which had engulfed corpuscles and other blood elements but also other cancer cells.

Hematophagy was found without difficulty in malignant growths, cancer-cell nests being formed from this habit.

Bucky and Kretschmer. On roentgen treatment of infantile pulmonary and bronchial glandular tuberculosis. *Ztschr. f. d. ges. physik. Therap.*, 1923, xxvii, 119.

Deep roentgen radiation has caused satisfactory improvement in children with bronchial glandular tuberculosis, and in some instances of pulmonary tuberculosis. With this treatment, no change in the mode of living was necessary. The effect is often much more lasting than the effects from change of living. The general state of health improves, weight and appetite are increased, and the children are mentally brighter.

Bumm. On roentgen carcinoma in the woman. *Verb. d. Ges. f. Geb. u. Gyn. Berl. Ztschr. f. Geb. u. Gyn.*, 1923, lxxxvi, 445.

It is well known that cutaneous cancroid may develop on the skin on the site of chronic roentgen dermatitis, which will have all the characteristics of malignant neoplasms and which by metastasis may cause death. Hesse, in 1911, published 94 of these cases. Lazarus later published 100. Generally these injuries were seen in persons handling roentgen rays professionally, and the lesions formed a parallel of those caused by tar or paraffin, or of the chimney-sweep cancer. Among the reports there are only 4 cases where the cause was therapeutic. It seems that acute manifestations are not so likely to form these cancroids as the chronic skin lesions caused by repeated small doses. Unless this were the case, one would find cancroid developing frequently on the abdominal wall in women.

A case of a woman, aged sixty-one, suffering from itching of the genitals, had been treated without success for years by means of ointment and compresses. During the menopause her condition became much worse. After the first roentgen application there was a decided aggravation; therefore, ointment and powders had again to be resorted to. Later, she was radiated for a year and three months, every two to three weeks, for ten or fifteen minutes, and four times radium was applied. Nine months after the treatment had been stopped, roentgen burns were found. Chamomile compresses and sun baths were of no avail. The entire genital region to the anus and the inguinal poles ulcerated, and the borders developed scirrhous stratified epithelial carcinoma. The vulva, clitoris, urethra, and hymen were not affected. The skin over the entire diseased area of the pathological tissue was removed, but a few months later recurrence set in.

Treatment should be made about three to six months after the necrosis is well divided off from the deeper layers, and complete surgical removal will be necessary.

Several times the author has seen carcinoma of the uterus develop after roentgen treatment, in cases where he was doubtful whether carcinoma and myoma had developed simultaneously, or were the consequence of chronic roentgen irritation.

Corica, A. Influence of roentgen rays on the respiratory metabolism of tuberculous children. *Pediatria*, 1923, xxxi, 868.

It was found that roentgen treatment of tuberculous children has a definite influence upon the respiratory quotient when the rays are applied to the lateral cervical region and the spleen, or the lateral part of the chin and the spleen, or the ribs and the lateral part of the knee. In some the anhydrid carbonic elimination was diminished, and the oxygen resorption increased. More oxygen was utilized. In 2 other cases there was a greater increase of carbonic anhydrid elimination, and the oxygen absorbed was less. However, in either instance, oxygen metabolism, or combustion, was improved. This influence upon the gaseous mechanism is similar to that experienced from the sun rays.

Doederlein, A. Therapy of gynecological cancer with radioactive substances. *Strahlentherapie*, 1923, xv, 766.

It cannot yet be definitely decided whether radium and mesothorium are equal, in their effect, to roentgen rays. They have the advantage of being harder than any rays so far produced by roentgen apparatus. Their scope of appliance, however, is more limited. The application does not take so much time as roentgen therapy, and does not cause the same high expenditures in the long run. The life of radium has been estimated at eighteen hundred years, and that of mesothorium at twenty years. The latter disappears in this span of time, down to a 25 per cent radium content. This vivid combustion going on within mesothorium may perhaps indicate that it acts somewhat differently than radium.

From 1912 to 1918, 1,016 women were treated with these substances. Among these, 962 were suffering from carcinoma of the female generative organs. The neck of the uterus was involved in 755 cases. All of these have been observed for five years. The results are that 103 of these cases have remained cured. This would amount to 13.2 per cent. Abdominal and vaginal extirpation of carcinomatous uteri gives an operative cure of 20 to 25 per cent. It would, however, be wrong to conclude that radiation with these substances is only half as valuable as operation. The patients treated by these substances are much more unfavorable cases than those applying for operation. Among the total number, there were only 110 which were operable. Of these 110 cases, the radioactive substances cured 48, which would amount to 43.6 per cent. There were 136 cases which were doubtful as to their operability, and of these, 22 per cent were healed. Among those who were entirely inoperable, 340, 6.7 per cent were healed. Even among the group of 169, which were desperate, 1 was cured. Among 65, vaginal carcinomata, no cure was affected by rays. It seems that in this region carcinoma spreads so rapidly into the surrounding tissues, that success is almost excluded. The same failure was registered in 14 cases of ovarian carcinoma. They all had to be operated on, and only 1 case was cured. One among 17 of vulvar carcinomata was cured, and none of 7 urethral carcinomata. Evidently, radiation fails here in the same manner as does operation. It may be that sensibilization of the carcinoma can be effected by applying the rays to the hypophysis.

Eikenbary, C. F. Fractures through the lower epiphysis of the humerus occurring in children. *J. Am. M. Ass.*, Jan. 12, 1924, lxxxii, 78–83.

This report is concerned entirely with fractures in children, occurring through or just above the lower epiphysis of the humerus. Report is made of 21 cases wherein treatment is entirely finished and the results known.

In 19 of the cases there was backward displacement, a few complete with overlapping. In the majority, there was not only backward placement, but some lateral displacement as well. In 3 instances, the lateral displacement was also complete. In only 2 cases was there a forward displacement of the epiphysis. In none of the cases was there any nerve involvement or circulatory disturbance. Twenty of the fractures were reduced without open operation; 1 case was reduced by open operation. Of the 21 cases in which the end-results are known, 20 are perfect, by which he means that there is no disability of which the patient is aware.

Treatment. A roentgenogram is first made in order to determine accurately the type of fracture, the degree of displacement and the amount of comminution. Unless the roentgenogram indicates that attempted reduction, by the closed method, is very likely to fail, he proceeds immediately with the reduction. No delay is made to permit of swelling to disappear. He feels very strongly that the quickest way to get rid of the swelling is to restore normal anatomic relations. Reduction is attempted under general anesthesia and under the roentgenoscope, and never any other way.

In fractures of the lower epiphysis of the humerus, the lower fragment to all intents and purposes becomes an integral part of the forearm. Keeping this in mind, he makes no effort to reduce these fractures by traction alone, a method that is almost sure to fail. He uses the same method as in the reduction of a Colles' and many other fractures. With the elbow firmly grasped, the movements of the parts closely watched on the screen, the existing deformity is greatly increased until the fragments may be unlocked and the edges made to slide past each other. The reverse procedure is then carried out, the lower fragment sliding forward and the elbow being flexed at the same time. It may be necessary to go through this procedure several times before a satisfactory replacement can be obtained. The same method of angulation and reversal of procedure is used to correct a lateral displacement. The arm is then put up in a molded plaster splint, although adhesive strips may work equally well. Usually the elbow is put up in acute flexion, but not always. Perhaps it would be better to say that it is put up in that position in which, under the roentgenoscope, it can be best maintained.

Formerly, he started physiotherapy in these cases as early as the tenth day. No harm came from this procedure, but little or nothing was accomplished. He now makes it a rule to start physiotherapy at the end of three weeks, unless the roentgenogram indicates that such a procedure would be unwise. He makes use of a well-trained physiotherapist. The length of time required for the physiotherapist to develop the maximum amount of motion is most variable. It ranges anywhere from a few weeks to several months.

He believes that the hardest factor to overcome in the development of motion is not adhesions, but muscle spasm. Relaxation is always difficult, and not infrequently taxes all the skill of the trained physiotherapist. It cannot be overcome forcibly. A long and patient study of muscle spasm is well worth while to the surgeon who is going to treat elbow fractures successfully.

FRIEDBERG, E. and SCIMONE, V. On the effect of ultraviolet rays on antibodies, antigens and the components of the Wassermann reaction. *Ztschr. f. Immunitaetsforsch. exp. Ther.*, 1923, I part, Orig., xxxvii, 341.

When hemolytic serum is radiated with ultraviolet light the amboceptor diminishes in proportion to the effectiveness of the serum, the attenuation and the albumin content. The albumin fraction is more resistant than the globulin fraction. The last part of the complement is more resistant. In eel serum the lytic function is more resistant than the toxic. Trypanosoma lose their infectivity much sooner than their motility when radiation is applied. Wassermann and Sachs Georgi positive sera of man and rabbit when radiated, and more especially when diluted and shaken, become negative. Radiation has no influence on negative sera and extracts.

GUARINI, CARLO. Roentgenologic research of the sella turcica in some ocular lesions. *La Riforma Medica*, 1923, xxxix, 892.

Papillitis may be of various origin—syphilitic, meningitic, tuberculous, it may be a diffuse process, acute infection (influenza, pneumonia, scarlatina), dyscrasia (diabetes, albuminuria, urticaria), lead poisoning, acute anemia, profuse loss of blood, lactation, menopause, hereditary. Stasis of the papilla is recognized by oculists as a sign of cerebral tumor, strabismus as a sign of increased intracranial pressure.

Often the oculist finds symptoms in the fundus of the eye which may suggest various morbid states. Exophthalmos is supposed in some cases to have arisen from trauma, which one, however, may not be able to trace. If roentgen rays are employed, the sella turcica may be found changed and a tumor of the hypophysis diagnosed.

The Coleschi technique is used for this purpose. Plates at 50 to 70 cm. distance from the anticathode.

The anteroposterior plane of the head must be exactly parallel with the plate. The head must be perfectly immobile, patient being advised to hold his breath. The rays must pass through the axis of the sella turcica. This point will be one which connects the center of a line going through the outer angles of the eyes and the upper border of the external auditory canal. Medium hard rays and exposure as short as possible. In the lateral projection, the sella turcica will be found about the center of the plate, if the pose is correct, immediately to the right of the anterior cranial fossa. It is semicircular with concavity upward, and shows a slight protuberance, the pituitary protuberance. It may form half a ring, or three-fourths, or almost a complete ring, or may form three-fourths of an oval, more or less elongated with longest axis in any direction, but always in the same sagittal plane. It may be rectangular, of which the anterior wall of the sella turcica, and the lamina quadrilata form the smaller sides. Behind, the sella turcica is limited by a vertical shadow. The pituitary tubercle is always well demonstrable in the newborn, in the adult it is hardly distinguishable.

Roentgen-ray diagnosis will often clear the etiology of blindness, and all cases should be subjected to this diagnosis.

SLUYS, M. Creation of multiple points of beta secondary rays in the midst of the tissues with a therapeutical aim (deep beta therapy). *Comp. Rend. de l'Acad. des Sc.*, Oct. 22, 1923, lxxvii, 800.

We have thought to create in the midst of the tissues an intense beta raying, in order to obtain a maximum biological effect.

The physical base of the technique is the following:

The maximum emission of the secondary beta rays for a given element, is when it is irradiated by a roentgen ray of a length slightly shorter than that which corresponds to a cessation of absorption of the element in question. We have employed metals of high atomic numbers, such as platinum, gold, bismuth, and uranium, of which the length of wave is very short, and the emission beta of an intense maximum. These permit us to obtain with waves of short length, on the one hand, considerable penetration, and on the other a very important emission of free electrons in the midst of the tissues.

Practically we have plunged into the regions to be treated, needles and supple or rigid threads, in pure metal or plated, or impregnated with insoluble salts of gold, platinum, bismuth or uranium, and have irradiated the region with roentgen rays of a wave-length corresponding to the maximum beta emission for each element. This irradiation was given with a Coolidge tube actuated by a constant tension, this tension being chosen to create the maximum of the wave-length to produce the maximum beta emission from the element selected. The threads or needles could be removed or allowed to remain after the irradiation.

The microscopic examinations and the histological sections recalled the effect produced by radium needles used in the treatment of tumors by curiepuncture.

Tyler, Albert F. Carcinoma of lingual thyroid with metastasis in the lungs. *Jour. Radiol.*, Nov., 1923, iv, 381–384.

By lingual thyroid is meant an aberrant thyroid, located in the root of the tongue; the most frequent location being in the posterior aspect, above the thyroid bone; of 45 cases reported, 41 were in females, and 4 in males.

The leading symptom is a feeling of pressure in the throat with difficult swallowing or breathing. Medical treatment has had but little beneficial effect. Roentgen rays or radium have not been tried on normal lingual thyroid. In the case reported surgical removal was impossible, and malignant change had taken place. Roentgen rays and radium were used with benefit. Metastasis had occurred, so that complete cure was impossible even by radiation. There have been no surgical deaths in the cases reported.

Healing has been rapid and complete, and the patients have quickly returned to their customary employment. It is important to determine before operation, the presence of thyroid in the normal location, to avoid myxedema. In the case reported, the disease extended over eight years. Roentgen-ray examination showed that there were some thirty nodules of metastasis, scattered through both lungs.

Surgical enucleation is the best treatment, roentgen-ray and radium treatment being beneficial in inoperable cases.

Ziegler. Roentgen treatment of laryngeal tuberculosis. *Beitraege z. kl. d. Tub.*, 1923, xvi, 182.

Roentgen treatment of laryngeal tuberculosis was first tried in France with good results and in Germany a few successful treatments had been reported. Only since roentgen treatment has been extensively used for pulmonary tuberculosis has application been made to the larynx. For the last two years the author has used it in certain types of throat trouble. He reports on 50 cases.

This is a provocative therapy, similar to krysolgan in its effects, but more powerful. It must be used only in patients with good reaction. Ulcerative destruction of the larynx forms a contraindication. It is indicated where the infiltrative process in the lungs is not too pronounced, and where the temperatures are satisfactory. Where used tentatively painful deglutition was much improved by two or three treatments. The anatomical state was not influenced, however.

Series of six treatments were made, two a week. The filter was 3 mm. thick, and consisted of aluminum. It was used ten times. After six treatments an intermission of three weeks was made. The rays were applied from the front or the side, as required by the site of the disease. Krysolgan was administered simultaneously. No fever or severe general reaction was experienced from this treatment. Some patients had a scratching sensation and slight discomfort in the larynx which soon subsided. On subsequent applications this was not felt. Slight hyperemia occurred in one instance. Swelling and pain stopped very soon.

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THE STUDY OF THE STERNUM BY THE ROENTGEN RAYS*

BY G. E. PFAHLER, M.D.

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THE study of the sternum, I believe, has been more or less neglected. More will be known of its diseases when roentgenologists investigate the sternum more or less routinely, especially when there is the slightest suspicion or possibility of its being diseased. Since my interest in this subject has been aroused, I have found metastatic carcinoma of the sternum, secondary to carcinoma of the breast, not uncommon.

Metastatic Carcinoma. One should investigate the sternum in all cases of carcinoma of the breast when the sternum is unusually prominent, especially if the prominence is of recent origin. This study should also be made when there is evidence of mediastinal carcinoma. There may be tenderness and redness, but the patient may have extensive metastatic carcinoma of the sternum and have no subjective symptoms.

The appearances of the sternum when involved by carcinoma are those of carcinoma of bone elsewhere. One finds an irregular decalcification, with no limiting margins of the disease, and no evidence of bone repair (unless there has been roentgen-ray treatment). Of course, if healing can be brought about by roentgen therapy, there will be a redeposit of lime salts and the bone regains a solid or normal appearance.

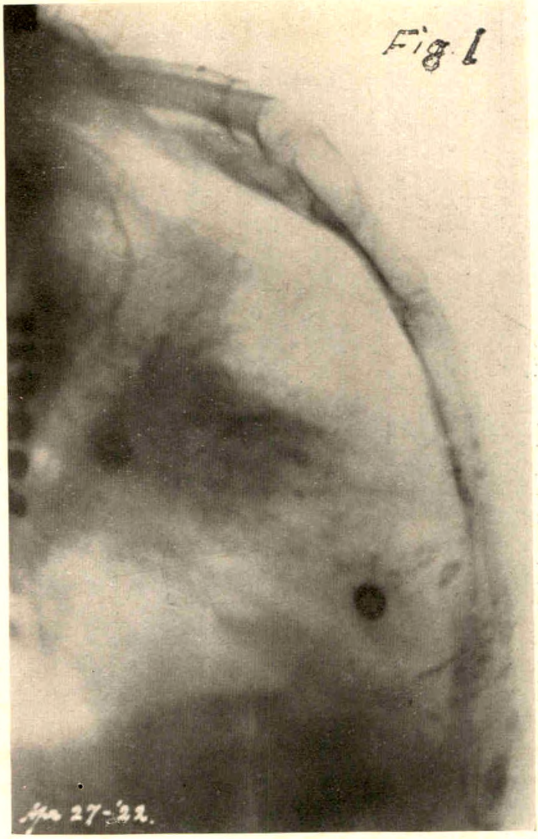

FIG. 1. Female, married, aged fifty-five. Referred by Drs. Haggert and Blake. Examination Apr. 27, 1922, shows a prominent normal sternum in the case of carcinoma of the breast. Notice the infiltration of the mediastinum.

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*Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, Jan. 24–26, 1924.

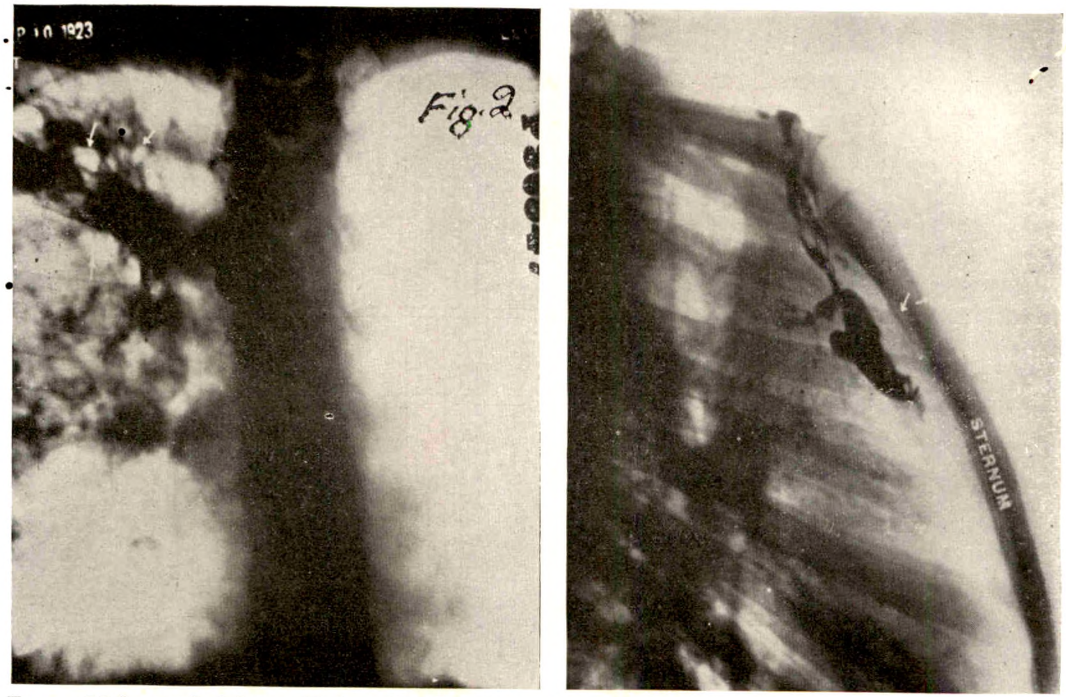

Fig. 2. Male, aged eighteen. Referred by Dr. Kirby, Sept. 10, 1923; having a sinus draining through the suprasternal notch, sinus injected by bismuth paste. Patient has pulmonary tuberculosis and tuberculosis of the sternum and mediastinum.

Tuberculosis of the sternum will present a similar appearance to tuberculosis of the bone elsewhere and consists of a local absorption of lime salts, with an adjacent general bone atrophy. In the cases that I have seen the disease was a direct extension from tuberculosis in the adjacent tissues.

Pressure necrosis may result from the pressure of a mediastinal tumor, especially if such a tumor is of a benign character. It may also result from the pressure of an aneurysm.

Necrosis from pressure will be indicated by a more homogeneous decalcification or thinning of the bone, with no evidence of invasion, and localized to the pressure area of the underlying tumor. The underlying tumor, of course, can always be demonstrated by roentgenoscopy and roentgenography. The interpretation is always aided by the study of the associated signs and symptoms.

Traumatism resulting in fractures or perforating wounds will, by its history and nature, generally suggest the sternal involvement, and the appearances will be similar to those of corresponding lesions in other bones.

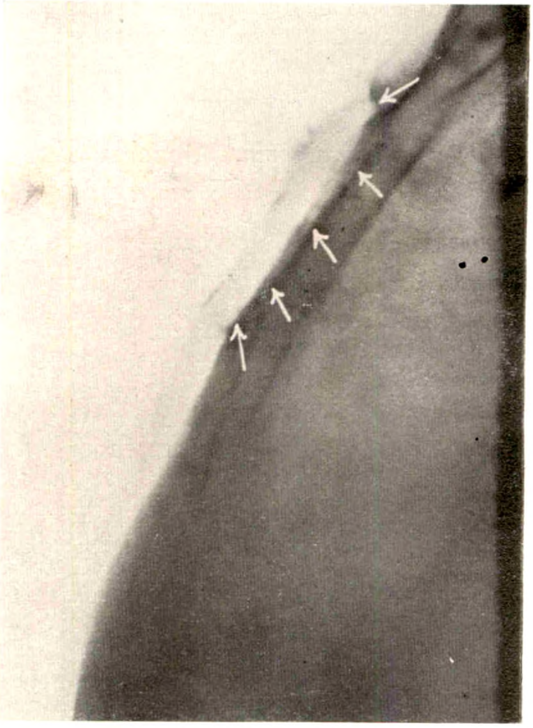

Fig. 3. Female, aged seventy-seven. Referred by Dr. Mair. Examination Feb. 19, 1923. Patient has had a tuberculous ulcer of the sternum for many years. Notice the erosion of the sternum.

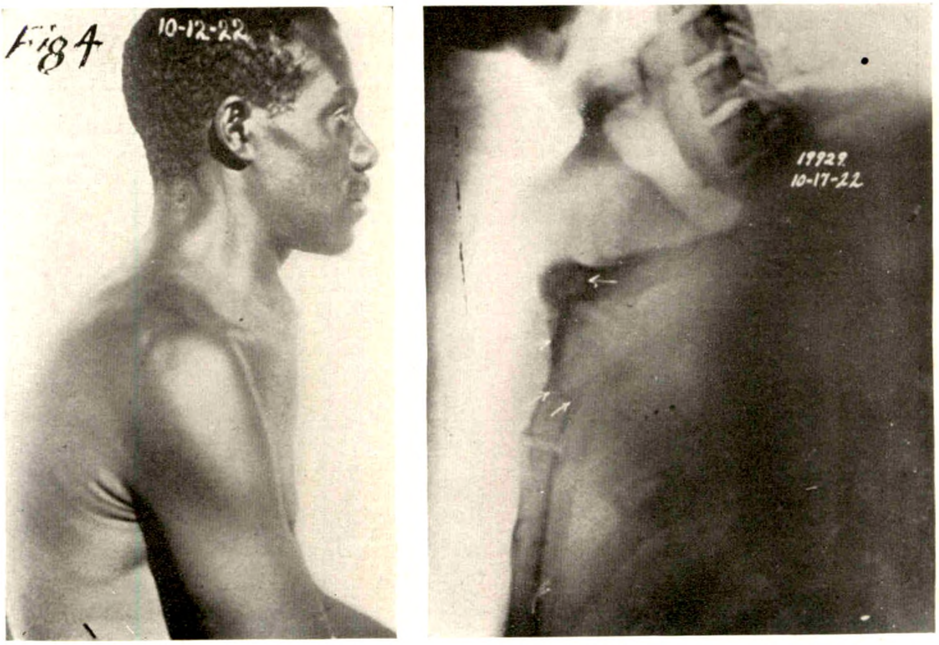

Fig. 4. Male, aged forty-two. Referred by Dr. Russell, Oct. 12, 1922. Suffering from aneurysm of the aorta and innominate, showing erosion of the manubrium.

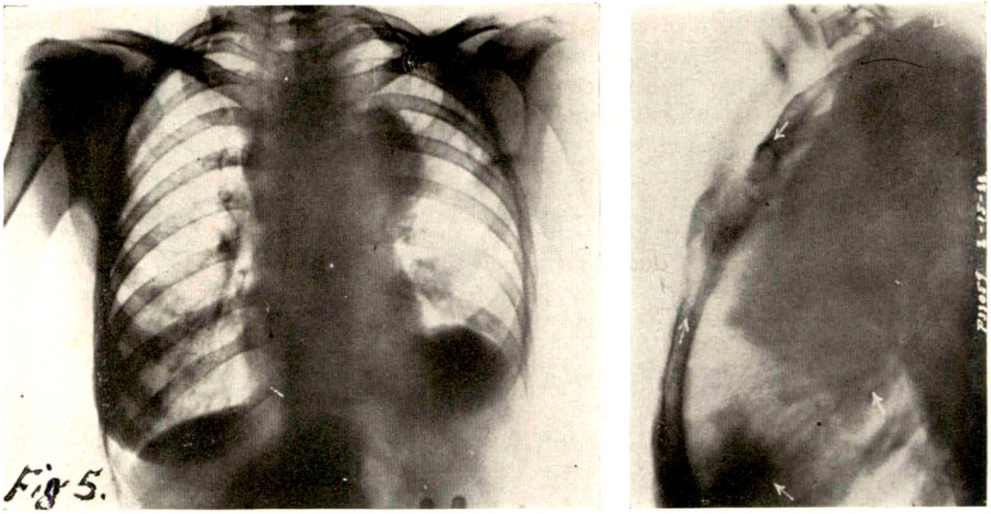

Fig. 5. Female, married. Referred by Dr. Haggert. Examination Feb. 9, 1922, shows mediastinal sarcoma, secondary to sarcoma of the hand; first operated upon twelve years ago; shows mediastinal tumor and sarcoma of the sternum.

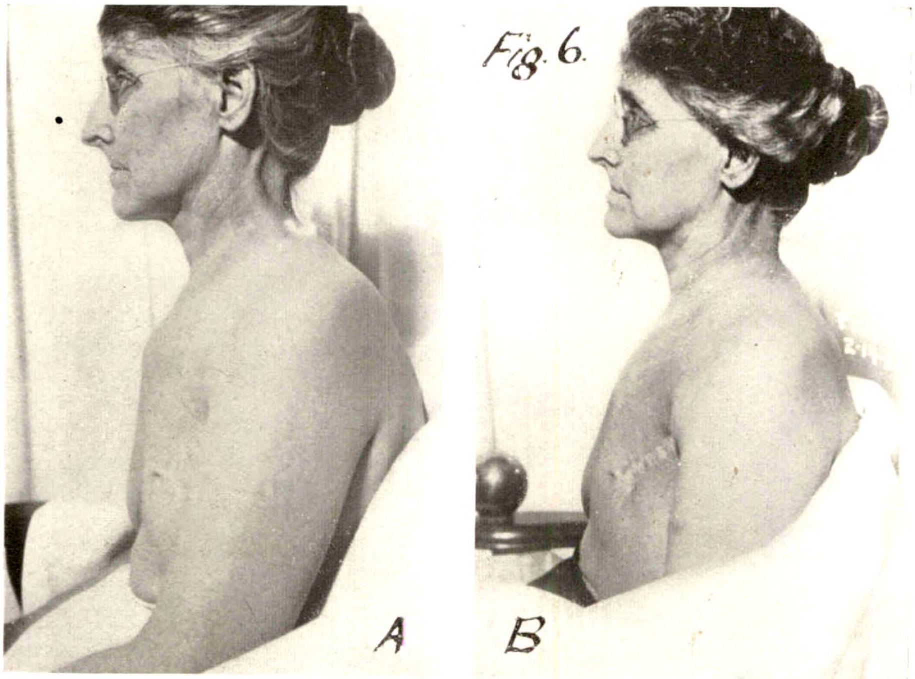

Fig. 6. Female, married, aged fifty-six. Referred by Dr. W. Fritz, Feb. 24, 1922. Mediastinal carcinoma secondary to carcinoma of the breast. A shows bulging of the sternum, May 8, 1921. B shows retraction or healing of the sternum, Feb. 14, 1922.

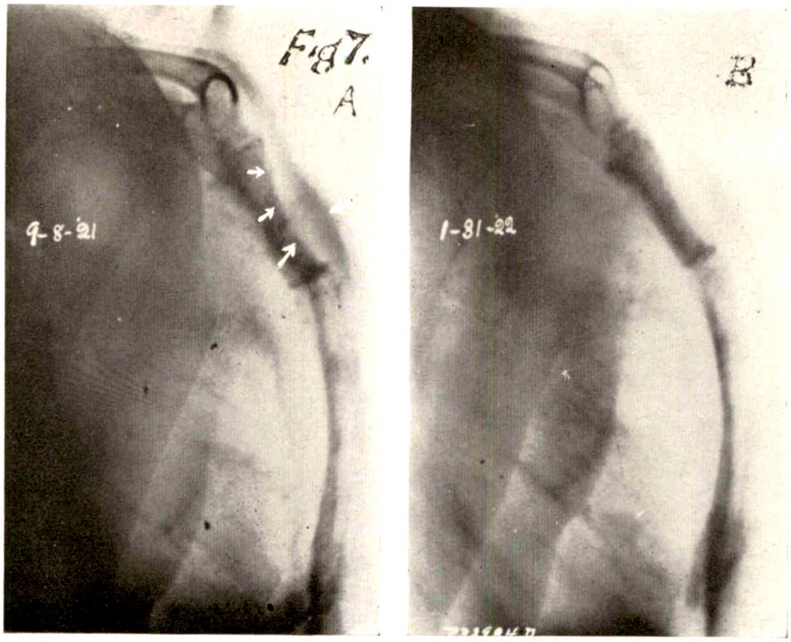

Fig. 7. Female, married, aged fifty-six. A shows a metastatic carcinoma of the sternum, Sept. 8, 1921. B shows healing of the sternum, Jan 31, 1923.

Technique. The usual anteroposterior or posteroanterior positions give no evidence of the sternum because of the dense overlying shadows of the spinal column. This difficulty is not overcome by the use of a Potter-Bucky diaphragm or stereoscopy. The sternum can be demonstrated only by eliminating the shadow of the spinal column. This can be done by three positions, all of which should be used.

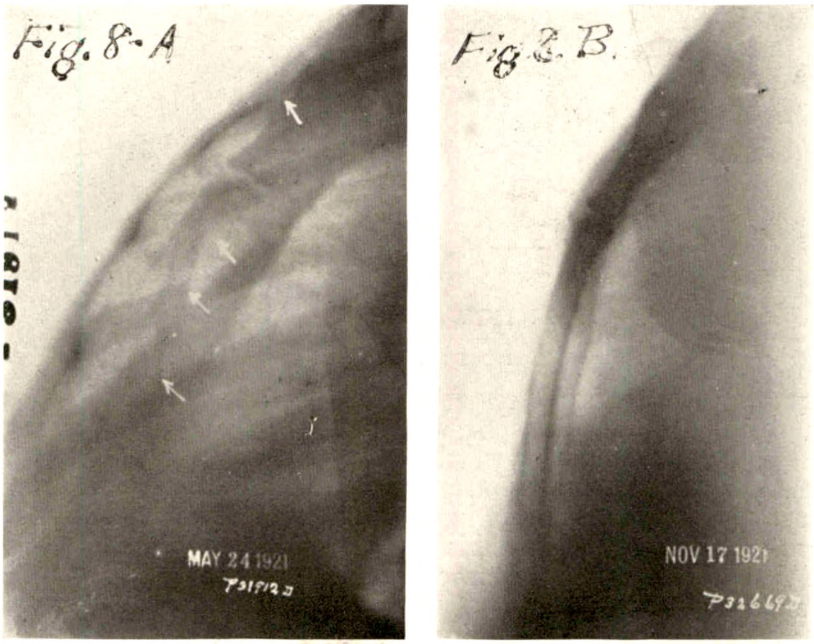

Fig. 8. Female, married, aged forty. Recurrent carcinoma of the breast with metastases in the mediastinum. A shows carcinoma of the sternum, May 24, 1921. B shows the sternum healed under the influence of roentgen-ray treatment, Nov. 17, 1921.

(1) The right oblique position, in which the rays are passed from the left posterior to the right anterior.

(2) The left oblique, which consists in passing the rays from the right posterior to the left anterior.

Both of these positions are best obtained by a preliminary study with the roentgenoscope, rotating the patient until the shadow of the spinal column, heart and aorta are projected away from the sternal shadow as far as is possible. This can be done best with the patient standing. After the exact position has been determined it is desirable to be able to replace the screen with a film or plate, without changing the position of the patient. It is, of course, necessary that the patient be held perfectly still, either by pressure of his own body against the frame, by having the patient hold firmly with his hands, or by binding him with a compression band.

(3) *The lateral position is probably the most important.* For this, it is also desirable to have the patient stand if possible. Roentgenoscopy is of little value. The film is placed in an upright plate holder. The tube is placed at a distance of 40 in. The patient is turned laterally; the hands are placed back of the body, and by means of a compression band the shoulders are forced back as far as possible. This causes the sternum to be projected forward as far as possible. The film is exposed during full inspiration.

A diaphragm or cone is chosen which will exactly cover an 8 × 10 in. film. We use duplitized, superspeed films with double intensifying screens, $4\frac{1}{2}$ in. parallel spark resistance in a Coolidge tube, and make an exposure of 8 to 12 seconds, with 30 ma. of current. The top of the film is placed on a level with the upper border of the clavicles. This technique will show the sternum clear of all other tissues. If the three positions are used, any disease of the sternum should be recognized.

ABSTRACT OF DISCUSSION

In answer to questions Dr. Pfahler described the technique for roentgenography of the sternum, as follows: The patient is erect, in a true lateral position and the tube centered over the middle of the sternum at a distance of 40 in. An 8 × 10 in. film and a small cone are used. The exposure factors are 30 ma., 4 to 4½ in. gap, and time 8 to 12 seconds, with double screens and superspeed films. Although the erect position is best, good results may also be obtained with the patient recumbent.

RYAN'S RULE

BY A. HOWARD PIRIE, M.D.

MONTREAL, CANADA

THIS instrument is constructed for convenience in treatment. In appearance it resembles a small telescope which may be reduced to a length of 4¼ in. or extended to a length of 16 in. It is marked every quarter of an inch by figures which represent the time of roentgen-ray dosage. These figures are for use with a 7-in. universal broad-focus Coolidge tube using 8 ma. and an equivalent spark-gap of 6 to 7 in. between blunt points.

To use the instrument the roentgen-ray tube is placed over the part to be treated. The skin target distance is not measured but one end of the telescopic rule is placed on the skin and the telescope is gradually extended until its other end touches the glass of the tube. The last visible number on the telescope represents the number of minutes and seconds required to give an epilation dose without filter under the above conditions.

A second set of numbers on the instrument represents the time for an erythema dose when using a 3 mm. aluminum filter. The instrument is made only to show the epilation dose and the surface erythema dose. The latter is a small dose which may be repeated each month for six months, producing intense browning at the end of that time.

In order to secure the figures placed upon the rule, I treated all my ringworm cases at a focus skin distance of 9 in. and uniformly obtained perfect epilation and a perfect regrowth of hair by using 8 ma. and 6 to 7 in. equivalent spark-gap for seventy seconds. Having established this to my satisfaction, I calculated the other figures by the inverse square of the distance law and found that they were correct in practice. The erythema dose was similarly established.

NEWER PHASES IN THE ROENTGEN INTERPRETATION OF DUODENAL ULCER*

BY JOSEPH S. DIAMOND, M.D.

NEW YORK CITY

BARELY a decade has passed since Cole ([1,2,3,4]) first reported his studies on the duodenal defect by means of serial roentgenography. His work made the diagnosis of post-pyloric or duodenal ulcer possible in a larger percentage of cases and helped to establish the validity of the direct method of roentgen diagnosis.

The indirect method of roentgen diagnosis in gastric and duodenal lesions which had its origin on the continent of Europe and is at the present time still in vogue in this country, has failed to supply even its staunchest adherents with more than presumptive evidence. Only the late manifestations met with in stenosis, such as, gastrectasia, with intermittent deep gastric peristalsis and retention can be regarded as immutable evidence of an organic lesion. This disturbed physiology is but an end result. The early symptom-group of rapid motility, exaggerated peristalsis and increased tone, are common to many conditions and are dependent upon the increased irritability of the autonomic nervous system. They are present in simple vagotonia, in the psychoneurotic and psychotic and in achylia gastrica. They arise also reflexly from diseases of other abdominal viscera such as the gall-bladder, appendix and the colon. They can be readily compared to the clinical symptom-group of fullness, pressure, pyrosis, belching and water-brash, which are common to so many functional and organic diseases arising from intra- and extra-gastric causes, not excluding even such remote conditions as tuberculosis, myocarditis, coronary disease, interstitial nephritis, etc. These group symptoms in themselves have no significance unless correlated with a definite clinical entity. Roentgenologically, as well as clinically, the indirect signs merely help to draw attention to an existing lesion without particularly specifying its character or location.

Cole in his work on the duodenal defect was the first to interpret duodenal ulcers on direct evidences of changes taking place in the duodenum. Numerous metaphorical terms were soon introduced in literature to specify the appearance of this defect. Carman and Miller ([5,6]) speak of the "pine tree" and "coral leaf" deformity and Holzknecht[7] of the "clover leaf." The term "defect," however, as employed here, is used in a broad sense, and does not make clear the actual pathological changes taking place in the duodenum. The meaning is unspecific and may equally be applied without any differentiation to an ulcer, scar, spasm, infiltration, adhesion or new growth.

In the roentgen pathology of gastric lesions the term "defective filling" implies a loss of substance or encroachment upon the lumen by a new growth. A gastric ulcer is always visualized as a crater filled with the contrast substance. As we shall see later, the factors that govern the roentgen pathology of duodenal ulcers are analogous to those governing gastric ulcers and the changes seen may be regarded as a miniature replica of the latter, such differences as exist being readily explained by the biological and anatomical characteristics as applied to the size and degree of irritability of the organ.

It will be the object of this paper to prove that a duodenal ulcer likewise manifests itself in the majority of instances in the presence of a niche and that the defect itself seldom represents the ulcer base proper.

Recently A. Åkerlund[8,9] of Stockholm took up at great length the studies of the duodenal deformity and attempted to interpret and classify these various deformities according to definite pathological and anatomical changes within the duodenum. He studied a series of 106 cases in whom he had the opportunity to compare the operative and autopsy findings with his series of roentgen findings in 69 cases. His work revealed that 60 per cent of duodenal ulcers manifest themselves in the form of a niche, similar to the gastric ulcer. He studied the mechanics of the duodenum and its behavior under pathological stimuli and gave a new interpretation to the duodenal defect, differentiating morphologically the functional from the organic defects.

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* Presented before THE NEW YORK ACADEMY OF MEDICINE, Jan. 17, 1924.

A series of 30 cases are here reported which were collected by me during a period of one year. They were all carefully studied by means of serial roentgenography, and many of them were reexamined under the influence of antispasmodics. The results were very gratifying in that 20 out of the 30 cases, i.e. 66 per cent, could be interpreted as niches. Only such cases were selected as gave classical symptoms of duodenal ulcer, and aside from the operatively proven cases, the others responded promptly to ulcer therapy.

ANATOMICAL CONSIDERATIONS

In order to understand fully the roentgen pathology of duodenal ulcers it is necessary to have a definite knowledge of certain anatomic and physiologic factors pertaining to the first portion of the duodenum, particularly the mechanism of its muscular structure. The first portion of the duodenum (bulbus duodeni) stands out from a structural viewpoint as a unique organ. Histologically it stands between the stomach and the small intestine, possessing some of the characteristics of both. It resembles the stomach in the absence of valvulae conniventes, possessing a smooth mucous membrane. This fact has made Cole consider it part of the stomach, naming it pilleus ventriculi (cap of stomach).

Duodenal Musculature. The muscular structure of the duodenum has a distribution somewhat similar to that of the stomach.

The longitudinal muscular coat completely envelops the duodenum. It shows, however, distinct variations in thickness in the different regions of the duodenum. Its greatest development and thickness can be seen along the lesser curvature border which is the continuation of the longitudinal muscular fibres of the lesser curvature of the stomach. This thickness is in marked contrast to other regions of the duodenum where the muscle bundles appear considerably thinner to the point of translucency, allowing the circular fibers to be seen through it. This enforcement of the longitudinal muscle fibers, forming a band as it were, along the lesser curvature border of the duodenum is a constant finding, and simulates somewhat the tenia coli. For the sake of convenience and due to the important rôle that this longitudinal bundle of muscle fibers plays in the mechanism of the duodenal bulb, it may be called tenia bulbus duodeni. It varies in width from 1 to 2½ cm. These fibers enter the pyloric sphincter and intertwine with terminal fibers of the longitudinal muscles of the stomach at the sphincteric ring. This arrangement is absent on the greater curvature side of the duodenum. Some of the longitudinal fibers enter also into the duodenohepatic ligament which is attached at the upper border of the duodenum and forms the only suspension mechanism of the duodenal bulb.

The circular muscle fibers, according to von Aufschneiter[10] originate in the lesser curvature border of the duodenum, running somewhat arc-like at an oblique angle to the longitudinal fibers at their point of origin, thus further strengthening the longitudinal bundle of fibers on the lesser curvature side (Fig. 1*a*).

This muscular arrangement of the first portion of the duodenum plus its suspension by the duodenohepatic ligament exert a strong influence upon the mechanism of the duodenum under pathological conditions, particularly upon the visualization and location of niches, and the roentgenological appearance of filling defects.

It is known that the place of predilection of ulcers in the duodenum is, as in the stomach, close to, or overriding the lesser curvature. Any irritation rising from an ulcer in this region causes an increased tension in the longitudinal muscle bundle, which, by virtue of its stronger contractile power and its suspension mechanism, forms a fulcrum towards which are drawn the circular muscle fibres in the same segment (Fig. 1*b*).

The effect is twofold. First, the drawing upwards of the adjoining tissues causes the visualization of the ulcers in profile, as they would override the lesser curvature; second, a localized contraction of the duodenum in the same segment of the ulcer which causes a narrowing of its lumen and gives roentgenologically the appearance of a defect, this defect being often mistaken for the ulcer base proper.

Often the contraction may be so intense, as to interfere with the filling and visualization of the niche. It is this particular phase that I wish to emphasize. The administration of antispasmodics in full physiological doses for several days will invariably cause a relaxation of the spasm to such an extent that the defect is diminished in size or may completely disappear, while a niche which was invisible before is seen filled out on the lesser curvature border.

With this method one can markedly increase the frequency of the visualization of niches, thus making the niche the most common roentgen deformity of duodenal ulcers. It is only in the presence of a scar or a marked infiltration with considerable encroachment upon the lumen that a niche cannot be visualized. Here we have the organic defect or the classical Cole defect.

Borders. A word as to the borders of the bulbus duodeni. The lateral borders of the duodenum are usually symmetrical and slightly convex. Occasionally the lesser-curvature side may be shorter, assuming then a slightly concave appearance. The base of the pyloric border is usually straight; rarely it may present slight variations appearing concave or convex, but like the lateral borders is always smooth and sharply outlined. The transition between the pyloric border and the sides of the bulb is usually round.

Nomenclature of Borders. The writer finds it preferable to preserve the terms used for the stomach, that is, the lesser and greater-curvature borders, for in truth they are continuations of the gastric borders, and no matter what position or direction the duodenum may assume this terminology remains always unchanged. The terms employed, "inner and outer" border, are confusing, for if the duodenum assume a transverse course, these borders, "outer and inner" would become "upper and lower." If the course were downward, they would then become completely reversed to "outer and inner."

Peristalsis. Definite peristaltic waves analogous to antral contractions can often be seen, particularly when the duodenum is in an irritable state, which may not arise necessarily from any intraduodenal lesion. This deep duodenal wave is often seen in association with deep gastric peristalsis. More commonly, however, the tonus changes described by Chaoul and Stierlin[11] are noted, the duodenum decreasing uniformly in size in the act of evacuation. This may be compared to a collapsing balloon, when the air escapes under pressure. The peristaltic waves can be differentiated from duodenal deformities by their transitory nature.

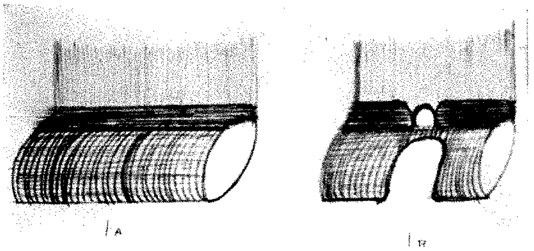

FIG. 1a. Diagrammatic sketch of the muscular arrangement in the first portion of the duodenum showing the thickness of the longitudinal bundle of muscle fibers at the lesser curvature border and the attachment of the duodenohepatic ligament.

FIG. 1b. Shows the mechanism of the muscular contraction in the presence of an ulcer at the lesser curvature.

Roentgen Pathology of Duodenal Ulcers. Duodenal ulcers manifest themselves roentgenologically in deformities which are dependent almost always upon a combination of two factors (1) organic changes (2) functional disturbances accompanying the organic lesion. The functional, like the organic changes, assume definite and characteristic forms.

Classification of the Roentgen Deformities in Duodenal Ulcer. The types of deformities encountered may occur singly or in a combination of any or all of them. They may be classified as follows:

(1) The *niche* is by far the most constant type and is dependent upon the filling of a crater by the contrast substance. It was found in 66 per cent of our series, 20 out of the 30 cases.

(2) The *defect,* a deformity which assumes definite characteristics as to con-

figuration and position, is usually associated with a niche, but may appear alone, and is the result, in the majority of instances, of functional disturbances. Less often it is due to organic changes such as induration, scar-formation and adhesions. It is most often seen on the greater curvature side.

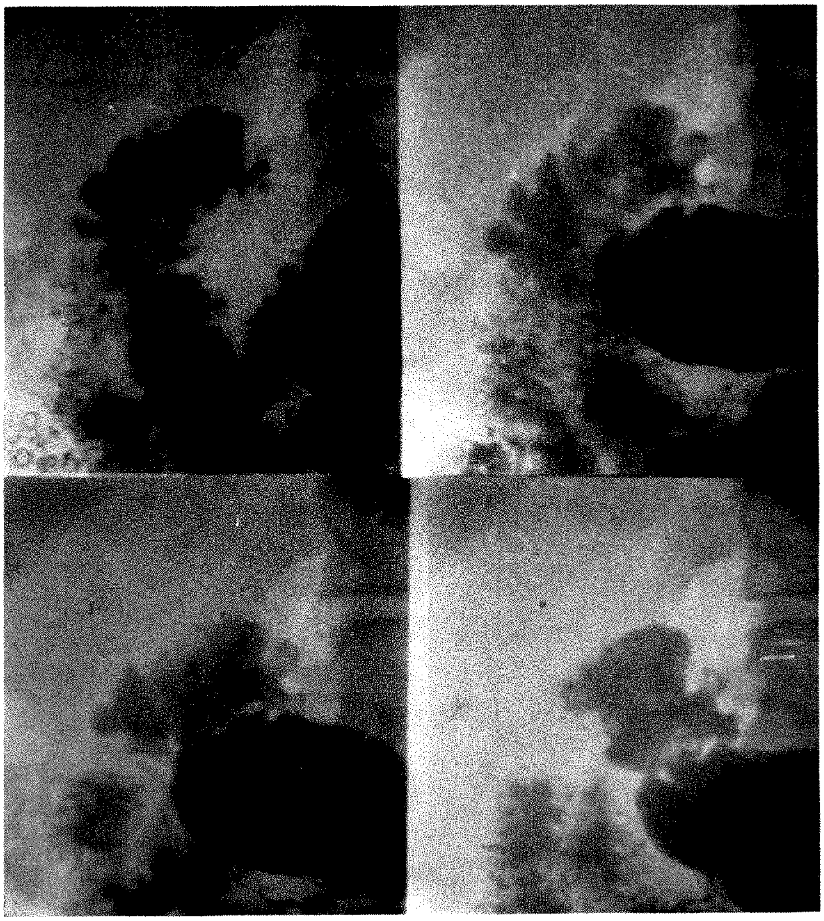

FIG. 2. Niche at the lesser curvature border of the duodenum with retraction of the same border. Also spastic incisura at the greater curvature border in the plane of the niche. Operatively proven case.

(3) *Retraction,* another characteristic deformity, always in close association with the niche, is likewise dependent upon spasm and rarely upon organic changes. It is usually situated on the lesser curvature side and is manifested by a shortening of the same border.

(4) *Diverticula formations,* confined to the base of the duodenum, are pouch-like in character and differ from the niches by changes in size and shape noted in the course of the serial examination, and are the result of both functional and organic changes in the duodenum.

Our series of 30 cases revealed 20 niches, or 66 per cent, out of which 14 or 70 per cent were on the lesser curvature, 5 or 25 per cent were on the greater curvature, 1 was an en face niche.

Twenty-four cases, or 80 per cent, presented defects, out of which 12, or 50 per cent, were associated with niches and 12 were not. Of the latter, 6 were organic defects, representing old callous ulcers. All the others were functional.

Nineteen niches or 95 per cent were associated with retraction, of which 12 presented an accompanying defect on the opposite side and 7 niches presented retraction only.

Diverticula in the sense of functional sacculations were met with in but 6 cases, the place of predilection being at the base of the duodenum.

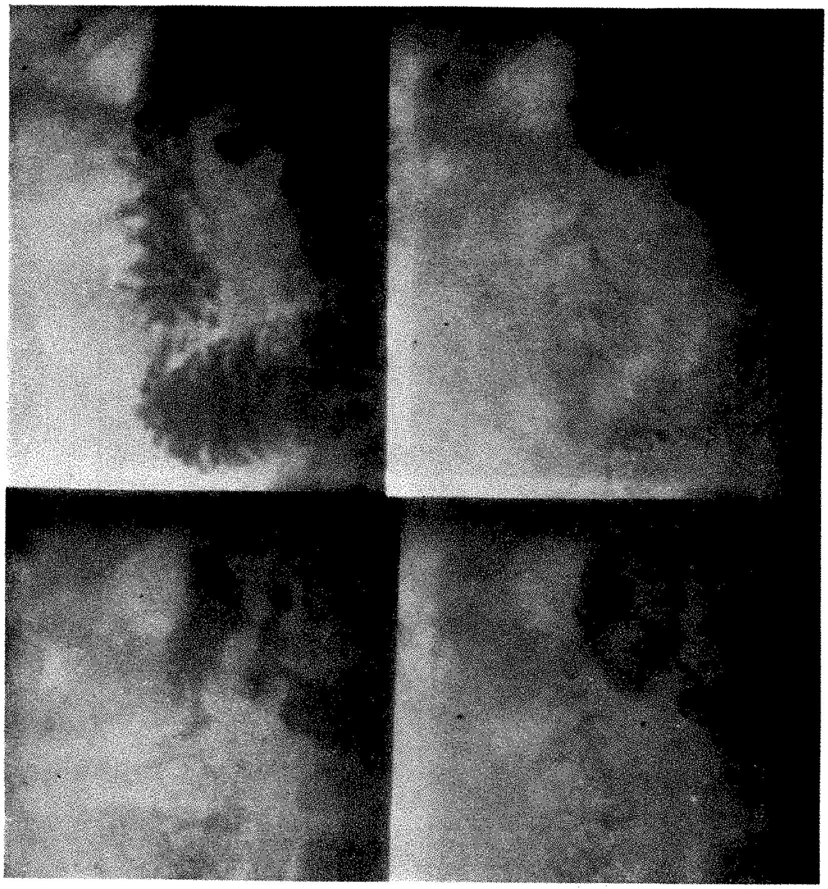

FIG. 3. Large niche at the lesser curvature border about ½ in. away from the pylorus. Retraction of the lesser curvature border and a marked function defect on the greater curvature side opposite the niche. Operatively proven case.

The Niche. The occurrence of a niche in the duodenum was considered for a long time as a rare manifestation. In 1914, Carman[12] reported but two niches out of a series of 198 operatively proven cases of duodenal ulcer. Prior to him, in 1912, Bier[13] reported a case where roentgenologically a large penetrating niche was demonstrable which operatively was found to have penetrated into the liver. George and Gerber[14, 15] however, in 1915, stated that with good technic a majority of the mucosal defects can be roentgenologically demonstrated. Åkerlund in his series of 102 cases was able to demonstrate the presence of a niche in 60 cases, approximately 60 per cent. In my own series of cases a niche was demonstrated in 66 per cent.

The niche may represent any stage of pathological change in the duodenal wall from the simple non-indurated mucosal ulcer to the penetrating and callous ulcer and even an ulcer scar covered with mucous membrane. The filling and visualization of the niche is dependent not only upon the ulcer crater itself, but also upon the existing irritability of the surrounding musculature, especially the muscularis mucosa through whose constriction is produced a flask-shape appearance (Figs. 2, 3, 4). Often this irritability may be so intense that the entire ulcer-bearing area is puckered up in a state of undue contraction as a protective measure, not permitting the contrast substance to enter the ulcerated area. Here, as we shall see later, the administration of an antispasmodic for a few days produces invariably a relaxed condition that allows the filling and visualization of a crater.

Place of Predilection. It is most commonly encountered on the lesser curvature side. Fifty-four out of 60 cases reported by Åkerlund were visualized on the lesser curvature. In our own series 14 were situated on the lesser curvature and 5 on the greater curvature (Fig. 5) and 1 was an enface niche (on mid-surface). Ulcers situated anatomically close to the lesser curvature, as has been pointed out, will appear roentgenologically on the lesser curvature, giving the impression, as it were, of overriding the lesser curvature. This is dependent upon the mechanical factors of the duodenal musculature before mentioned, that is, the structure at the lesser curvature border forms a fulcrum which by its stronger contraction causes the drawing upward of the adjoining tissue, with the result that even a lesion situated a short distance away on the anterior or posterior wall becomes approximated towards the lesser curvature side.

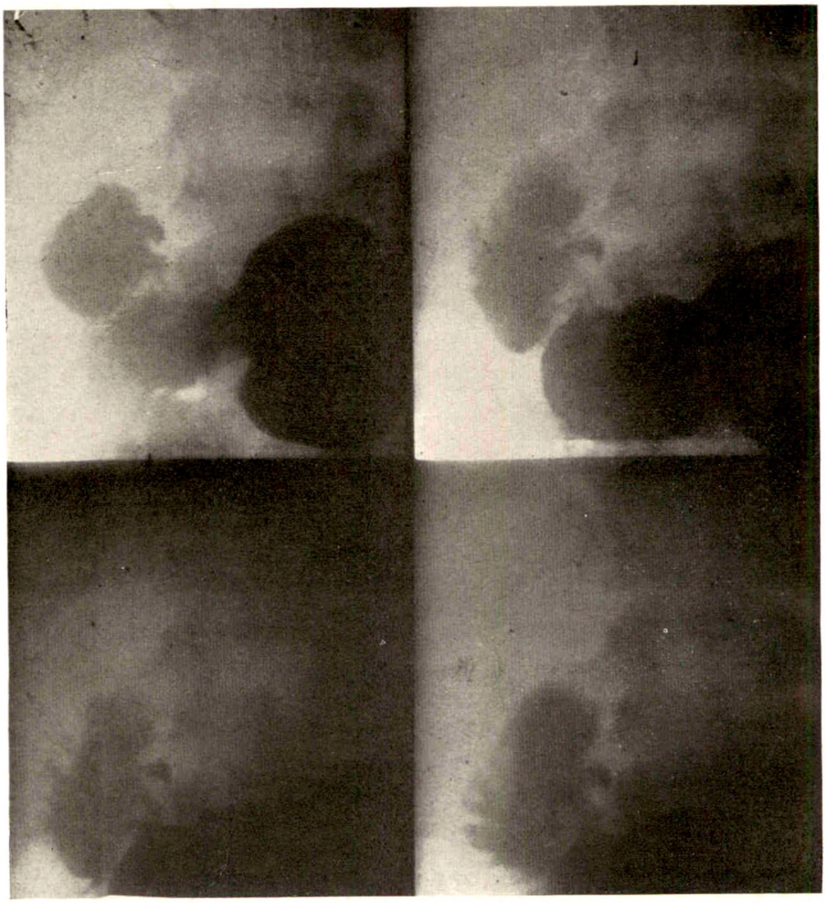

Fig. 4. Niche on the lesser curvature side with retraction of the same border.

The niche in the duodenum is often accompanied by characteristic deformities. These deformities are functional in character and are analogous to the roentgen signs accompanying gastric ulcer of the lesser-curvature type. They are, however, more constant and more pronounced in the duodenum than in the stomach. They are, as we shall see in the succeeding paragraphs, (*a*) the segmental contracture or incisura, appearing usually on the greater curvature opposite the lesion and (*b*) a puckering or contraction in the immediate vicinity of the lesion. Niches on the greater curvature of the duodenum may appear as small diverticular projections and may or may not be accompanied by any other signs in the duodenum.

The Duodenal Defect. The term defect when used to describe duodenal pathology embraces all changes in form which may arise from muscular contractions or retractions, spastic incisuras, infiltrations, scar formations and constrictions resulting from scars. Also from extraneous causes such as pressure from neighboring organs and adhesions. Tumors of the duodenum are rare.

For a long time the defect was considered to be the result of organic causes only. Cole attributed the constant deformity in the duodenal contour to organic changes caused by induration or cicatricial contraction surrounding the crater of an ulcer and also to periduodenal adhesions. Later Carman[15] expressed the belief that a similar defect could be produced by a spastic contraction in the duodenal wall opposite to, or surrounding the ulcer-bearing area. However, not until 1919 was there an attempt made to give definite interpretation of the pathogenesis of this defect. Åkerlund in his series of cases first observed the disparity between the roentgen findings and the operation or autopsy findings. The roentgen defects indicating extreme narrowing of the duodenal lumen are but seldom found during operation or postmortem. In this respect they are similar to

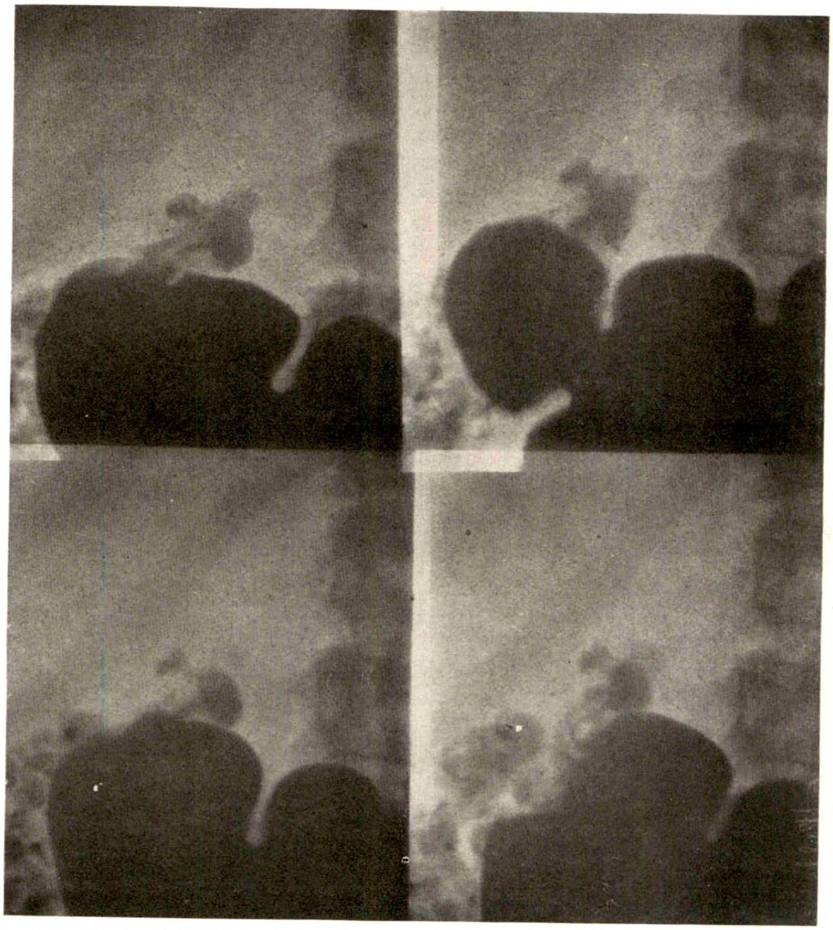

FIG. 5. Niche on the greater curvature side. Notice also diverticulum pouch at base of duodenum. Operatively proven case.

gastric incisuras or other forms of gastric spasm. These defects vary in size during the same examination and are considerably influenced by several days' administration of belladonna. It is the custom of the writer after the preliminary examination to administer to the patient 20 to 25 drops of tincture of belladonna every 4 hours for 48 hours, simultaneously restricting the patient to a milk diet. At times even alkalies may be necessary. A marked relaxation of the spasticity takes place so that the lumen of the duodenum appears wider, and often a niche which was not visualized before is seen protruding from the lesser curvature (Fig. 6). Furthermore, these defects gradually diminish in size and actually disappear during prolonged medical therapy. One must conclude, therefore, that this local defect is due to a spastic contraction caused by the presence of an ulcer, somewhat analogous to gastrospasm opposite the niche. The organic causes such as induration, and scar formation play but a minor part in the formation of these defects. These are always accompanied by the spastic factor which is the predominating component.

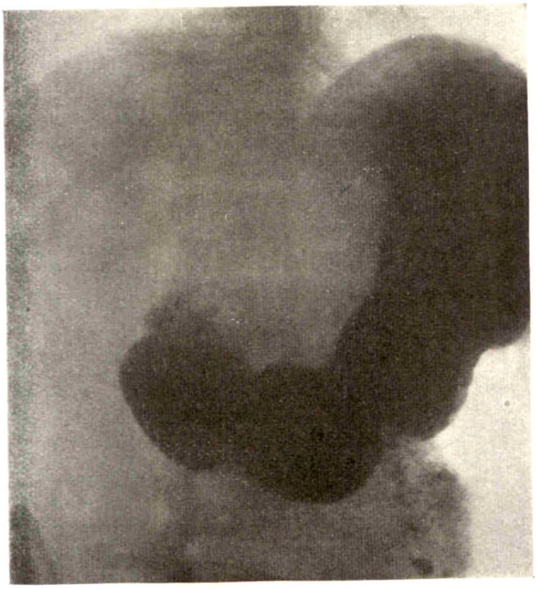

Fig. 6. Complete relaxation of the duodenum after several days' administration of belladonna and restriction to milk diet. Notice well-filled niche on the lesser curvature side and total disappearane of a previously existing defect on greater curvature side.

The spastic defect is almost invariably found on the greater curvature of the duodenum, in the plane of the ulcer; occasionally at the base of the duodenum (Fig. 7) or in the region of the pyloric sphincter proper. Sometimes there may be an hour glass deformity, a circular spastic contraction arising from both borders of the duodenum.

The organic defect is more often found on the lesser curvature border.

The spastic defect is more or less rounded in outline, broad and often very deep, and possesses smooth borders giving the appearance of a finger-print (Fig. 3). These defects in the greater curvature may be wider than a finger's breadth and may at times occupy the major portion of the duodenum, encroaching deeply so that the lumen of the duodenum is reduced to the diameter of a match stick or a thread. It may so alter the configuration of the duodenum that the duodenum becomes difficult of recognition, being divided into two separate portions with or without any connecting link. Less frequently does the defect appear as a narrow sharp incisura (Fig. 2) of the type encountered in the stomach. These contractions may be double and adjacent to each other, or separated by a narrow tongue-like projection.

This segmental contracture is brought about by the contraction of the circular muscle fibers, and is likewise dependent upon the anatomical and mechanical factors before mentioned. These weaker circular fibers contract towards the fulcrum at the lesser curvature side. One gets the impression that a localized area of the duodenal wall is drawn up and bound as it were to the lesser curvature side (Figs. 3, 7). In lesions close to the base of the duodenum the pyloric sphincter is pulled over to the side of the lesion along with the spastic contracture. The defect can often be seen long in advance of the appearance of the niche and may persist after the niche has disappeared in the course of medical treatment. In cases where a niche is not visualized the ulcer is usually found opposite the defect. Organic causation enters less often into the formation of such defects.

The organic defects are irregular in outline, they may be angular and are constant in size. They lack the rounded form, the depth and variability.

In our series, 24 cases presented defects, out of which 18 were functional and 6 organic, the latter representing old callous ulcers.

deformity associated with a niche (Fig. 3). In well marked cases of unilateral retraction one gets the impression that only the outer half of the bulb is filled at that particular level. Similar retraction occurs in gastric ulcer in lesser curvature niches, the best illustration is the Schmieden and Hiertel snail-form or tobacco-pouch stomach when the lesser curvature is shortened and there is an approximation of the horizontal to the vertical portion. This, of course, is an extreme illustration. Minor retractions surrounding the gastric niches are less manifest than in the duodenum in view of the fact that the lesser curvature of the stomach is normally concave in contradistinction to the convexity of the duodenal borders.

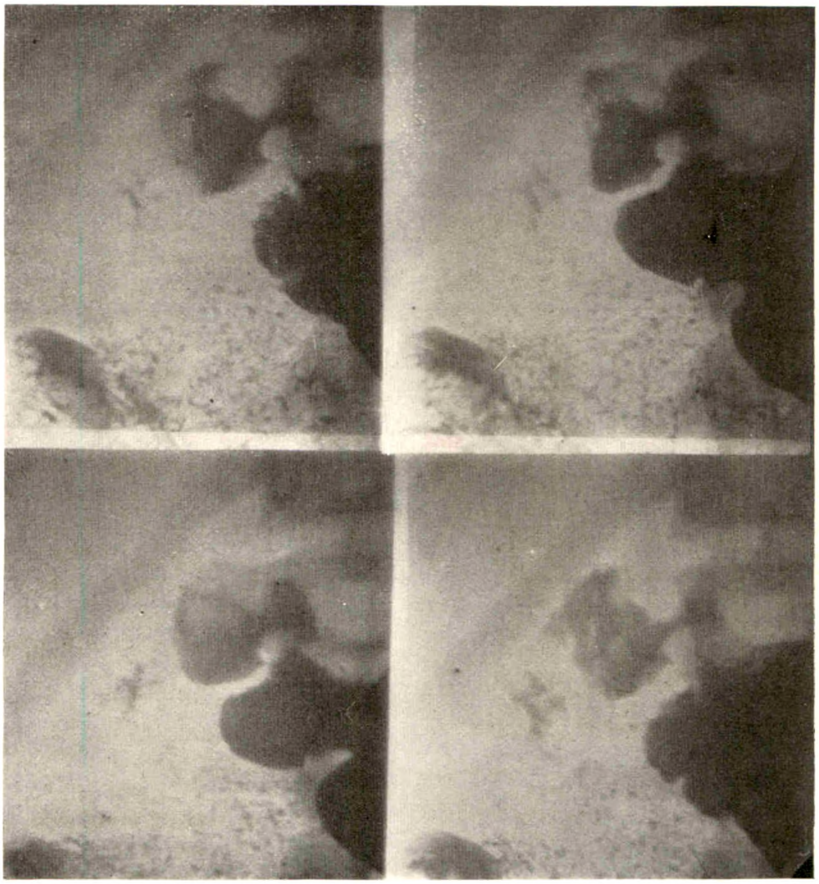
FIG. 7. Functional defect at base of duodenum accompanying mucous ulcer.

Bulb Retraction. By retraction of the duodenum is understood contraction of the longitudinal muscle fibers occurring usually on the lesser curvature border and always surrounding the base of a niche. The retracted side then appears shortened and drawn in for a short distance so that a normally convex border changes into a distinct concavity, from the center of which a niche protrudes (Figs. 2, 3, 4). When the circular muscle fibers are simultaneously in a state of contraction, we then have the picture of the classical

Diverticulum Associated with Duodenal Ulcer. The diverticulum associated with a duodenal ulcer consists of a pouching of a portion of the duodenal wall situated in close proximity to the ulcer. They are characterized by containing an intact lining of mucous membrane. Roentgenologically, they are of significance in that they may be often mistaken for niches. They can, however, be differentiated from these by their ability to contract, changing in size and contour from plate to plate (Figs. 5, 7). They participate in function with the remainder of the duodenum and can be seen to fill and empty. The places of predilection are the basal portion of the duodenum. Carman and Miller speak of the diverticulum as a sac-like addition to the bulb, always proximal to the site of the ulcer. Åkerlund mentions two types of diverticula, the larger sacculation occurring mostly on the greater-curvature side while the smaller one, more circumscribed, appears on the lesser curvature. The larger sacculations on the greater-curvature side are the result of spastic contractions on the distal portion of the duodenum. The smaller diverticula on the lesser-curvature side usually take their origin from the formation of longitudinal folds in the vicinity of the ulcer, which result from the shortening and retraction of the longitudinal muscle fibers. The continued constriction of the lumen causes a prolonged back pressure which results in diverticulum formation. These latter are usually sharply circumscribed and are situated in close proximity to the pylorus and can be mistaken for the niche proper. Careful observation and study on the serial exposure will aid in the differential diagnosis.

Organic stenosis of the duodenum distally situated will also give rise to similar diverticula orally situated from the stenosis, the so-called "prestenotic diverticula." Traction diverticula are of rarer occurrence and are described by George and Leonard[17] as caused by the formation of adhesions to the surrounding organs, from periduodenitis in the ulcer region.

Non-pathological Deformities of the Bulb. In normal individuals changes in contour are met with occasionally. These are usually broad, smooth, arc-like depressions, mostly on the lesser curvature, but less often on its greater curvature. These are caused by pressure from a distended gall-bladder. Cole speaks of an indentation near the apex of the bulb which is due to pressure on the pars-descendens by the group of vessels running from the duodenum to the liver along the duodenohepatic ligament. These are the portal vein, the common duct and the hepatic artery.

CONCLUSIONS

Ulcer of the duodenum always produces morphological changes in the configuration of the duodenum. Only in rare conditions, in the absence of an accompanying spasm, such as in mucous ulcer, may the duodenum appear normal. In the series herein studied a definite anatomical deformity was noted in all. Aside from the operative cases only such material is here presented as gave clinically the classical symptom complex of duodenal ulcer and responded promptly to the therapeutic test. Cole holds that a symmetrical cap with a normal pyloric sphincter justifies a negative diagnosis of post-pyloric ulcer. Experience, however, has proven that a deformity which repeats itself in a series of exposures cannot be invalidated by the presence of one apparently normal bulb shadow. The variability of the accompanying spasm may at times obscure the lesion, especially a so-called enface niche and more so when situated on the posterior wall. Carman quotes several cases with a normal outline of the duodenum where upon exploration an ulcer was found. At times, however, the surgeon may be unable to find palpatory evidence of the ulcer when the roentgen ray indicates unmistakable evidence of ulcer. This occurs when the usual induration accompanying an ulcer is wanting as takes place in the superficial or florid ulcer. Numerous cases are cited in the literature (Cole[18] Åkerlund, etc.) in which the roentgen examination indicated the presence of a niche and on section at autopsy large superficial or deep ulcers were found, but no palpable ulcer could be demonstrated during laparotomy. One must take cognizance of this important phase of absence of palpatory signs of ulcer, and negative surgical diagnosis of ulcer is unjustifiable unless the duodenum is opened and inspected. We must also recognize the fact that in some instances the roentgen diagnosis supersedes the exploratory laparotomy.

In the interpretation of the duodenal deformities an effort must be made to recognize the actual lesion taking place within the duodenum and express it from a pathological and anatomical standpoint. We must differentiate between a niche, infiltration, scar and spastic contracture. Errors will be eliminated if one will follow a definite plan and apply himself to study minutely the character of the changes in each border, always bearing in mind the pathological entities which affect the duodenum and the manner in which they express themselves under the roentgen ray.

SUMMARY

Several new phases in the understanding of the roentgen appearance of duodenal ulcers have been brought forth. An attempt was made to interpret the manifestations upon the basis of anatomical and pathological changes.

1. The architectural structure of the first portion of the duodenum and its influence upon the configuration of the duodenum in ulcer lesions has been gone into at length.

2. It has been shown that a supporting structure, or a fulcrum, is formed on the lesser-curvature side of the bulb brought about by the larger number of longitudinal muscle fibers continued from the lesser curvature of the stomach, forming a thick bundle, as it were, simulating the tenia coli which in view of its importance may be called "tenia bulb. duodeni." This is further strengthened by the suspensory effect of the duodenohepatic ligament.

3. A series of 30 cases are here presented revealing 20, or 66 per cent, niches, 18 functional defects, 12 of which are associated with niches, 6 organic defects representing old callous ulcers; 19, or 95 per cent, of the 20 niches revealed an accompanying retraction. Diverticula were noted six times.

4. It has been shown that the most constant roentgen finding of the duodenal ulcer was the niche, which may vary from the mucosal defect to a deep penetrating crater.

5. It has been further shown that a duodenal defect is most often functional in nature and is produced by a contraction of the circular muscle fibers upon the longitudinal bundles on the lesser curvature side, and that it seldom represents the ulcer base, the ulcer being usually opposite to and in the same segment of the defect. Less often is the defect produced by organic changes such as scar formation or induration.

6. Another type of spastic contracture has been shown, "retraction," most often found on the lesser-curvature side, surrounding the base of the niche, and due to contraction of the longitudinal bundle itself, thus often intensifying the appearance and size of the niche.

7. The administration of belladonna for forty-eight hours and the restriction of the patient to a milk diet, invariably causes a relaxation of the accompanying spasm, thus permitting the filling of a niche which was not visualized in the previous examination. This method of reexamination has increased the number of visualized niches.

8. The occurrence of diverticula situated always orally to the lesion has been mentioned. These are usually pulsion diverticula produced by functional or organic constrictions in the distal portion of the duodenum. Their differentiation from niche has been pointed out.

9. Careful and detailed study of the duodenal contour in serial roentgenography based upon the above anatomical and pathological considerations will enhance the diagnosis of duodenal ulcer and reduce the failures to a minimum. The old indirect method has little or no value in the diagnosis of duodenal ulcers, particularly in the early stages, and cannot be relied upon, since a multitude of other conditions will give similar manifestations.

I wish to express my thanks to Dr. J. Fierstein for his assistance in the compilation of the literature.

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THE EFFECT OF DIRECT RADIATION OVER THE PRECORDIUM ON THE HEART SIZE, THE HEART MECHANISM AND THE MYOCARDIUM OF RABBITS*

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With the continued increase of roentgenotherapy in chest conditions which frequently involves exposure of the heart, especially in the treatment of mediastinal tumors, it seems important to know the effect of the roentgen ray on the myocardium as to pathology and function. Many excellent studies have been reported by Whipple[1,2] and his colleagues, and by Denis, Martin and Aldrich[3] on changes occurring in different organs after radiation, and their relation to general systemic reactions. So far, however, we have been unable to find any report except on the histological changes of heart muscle and these have been limited to studies on animals given comparatively large treatments and not observed for the effect of small frequent irradiations over the heart.

In this study sixteen rabbits were subjected to direct radiation over the precordium. Some of the rabbits were given large single doses or moderately large repeated doses, others received small doses at frequent intervals over a period of several months. Seven additional rabbits were radiated over the abdomen to determine any indirect effect of the roentgen rays on the heart. The total exposures varied from fifteen minutes to three hours and twenty minutes; the single doses varied from five minutes to one hour and fifteen minutes. The schedule, the amount of treatment and the weights are shown in the accompanying chart.

The technique used in giving the treatments was as follows: Each rabbit was placed on an animal board and held firmly in position on its back. The body except for the area exposed to radiation was covered with a leaded sheet supported by an upright standard. In the rabbits treated over the precordium the covering was adjusted so as to allow the penetration of the rays through an opening 2.5 by 3 cm. in diameter. In the rabbits studied for the effect of indirect radiation the opening over the thorax was covered and the part of the leaded sheet over the lower abdomen was removed. Electrocardiographic tracings and roentgenograms were made before radiation and at frequent intervals during treatment to determine any progressive changes that might occur in heart size, and rate or type of electrocardiograms. The roentgenograms were taken at a distance of 4 ft. with a spark gap of 4½ in., 30 ma. and an exposure of 7 seconds.

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* From the Medical Clinic of the Peter Bent Brigham Hospital and the Department of Medicine of the Harvard Medical School; Submitted for publication Jan. 18, 1924.

Rabbit	Weight in Kg. at Beginning of Treatment	Weight in Kg. at Post-mortem	Weight of Heart in Grams	Amount of Each Treatment (Milliampere Minutes)	Frequency of Treatments	Total Exposure (Milliampere Minutes)	Evidences of Toxicity	Interval between First Treatment and Death	Interval between Last Treatment and Death
A	2.5	2.4	8.6	150	Every 3 wk.	1000		6 months	1 month
B	3.0	3.4	8.1	25	Twice each week	775	0	6½ months	5 weeks
C	1.8	1.8	5.35	225	Single	225	+	5 days	5 days
D	3.5	2.8	8.9	50	Once a wk.	150	+	15 days	1 day
E	3.8	2.8	8.8	225	Every 3 wk.	525	+	36 days	14 days
F	3.2	3.0	6.6	75	Once a wk.	1000	0	6 months	5 weeks
G	2.6	2.5	6.6	40	Twice each week	960	0	5 months	2 weeks
H	2.5	2.0	5.1	75	Once a wk.	750	slight	4½ months	5 weeks
I	2.3	2.3	6.35	300	Once a mo.	600	+	6 weeks	3 weeks
K	2.4	1.9	4.3	300	Once a mo.	900	+	4 months	7 weeks
L	2.5	2.5	7.1	375	Single	375	0	12 hours	12 hours
M	2.2	2.2	5.25	75	Single	75	0	18 days	18 days
O	2.5	2.5	6.2	75	Single	75	0	12 hours	12 hours
Q				75	Single	75	0	10 hours	10 hours
R				75	Single	75	0	12 hours	12 hours
S				75	Single	75	0	12 hours	12 hours
P	1.8	1.8	3.8	150	Single over abdomen	150	0	18 days	18 days
T				300	Single over abdomen	300	+	7 days	7 days
V				300	Single over abdomen	300	+	7 days	7 days
W				225	Single over abdomen	225	±	21 days	21 days
X	2.8	2.8	6.7	300	Single over abdomen	300	0	1 day	1 day
Y	3.4	3.3	8.3	300	Single over abdomen	300	0	1 day	1 day
Z	2.4	2.5	4.8	225	Single over abdomen	225	0	1 day	1 day

In estimating the changes in heart size the heart shadows were outlined on the roentgen film with pencil and a silhouette was traced from this on smooth white paper.[4] The silhouettes were then carefully cut and weighed, the weight being accurate to 1 mgm. In comparing the silhouettes the position of the animal was taken into consideration; when there was any marked evidence of distortion, the film was discarded.

It will be noted in the chart that one rabbit (Rabbit B) on which daily electrocardiograms were obtained over a period of three weeks, during which time the rabbit was receiving five-minute treatments twice each week, showed no change in the heart tracings. Other rabbits given less frequent treatment but in larger doses also failed to show the slightest variation in heart mechanism. The only electrocardiographic evidence of possible roentgen-ray effect occurred in Rabbit F which showed ventricular extrasystoles after two hours and five minutes of radiation given in fifteen minute doses once a week. These extrasystoles disappeared after treatment was stopped.

The roentgen-ray studies showed no appreciable change in heart size. In observing the rabbits treated over the thorax, many of which lived out of doors and were allowed to run in a large enclosure, no evidence of myocardial insufficiency was obtained. With the exception of those animals that developed infections, gastric symptoms, or loss of weight, all rabbits appeared in good health and maintained normal appetites. Deaths occurred in five animals of this group. Rabbits C and D succumbed to intercurrent infections. Rabbit E, suffering possibly from the toxic effects of a badly infected foot and an accidental exposure over the abdomen, died following a marked diarrhea. Rabbit H also died after four months of treatment and Rabbit I after two months of radiation, both suffering from pulmonary complications. All other rabbits irradiated over the precordium were killed by ether. Of the group treated over the abdomen, one animal was killed after eight days, not having shown any signs of toxemia. The other animals in the group were killed five to seven days after the onset of diarrhea. The heart silhouettes and electrocardiograms in these rabbits failed to show any change in heart size or mechanism.

There were no constant pathological findings in the hearts at post mortem. Rabbits E and D showed a few whitish spots on the myocardium and there were clumps of fibrin in the pericardium of Rabbit I. Otherwise the gross examinations were practically negative. The histology in several instances showed small areas of necrosis or fatty infiltration in the heart muscle, but the findings were not characteristic of any special degenerative myocardial change. They were not unlike the picture described by MacCallum[5] of the heart muscle during the course of varying infections, intoxications and nutritive disturbances.

SUMMARY

There were no definite changes in heart size, or histology to suggest that direct radiation over the precordium caused a diseased myocardium in rabbits. The pathological findings were not unlike those described in cases of infection and nutritional disturbances. Variations in the mechanism occurred in only one rabbit.

We wish to thank Drs. S. A. Levine, M. C. Sosman, and J. R. Wilson for many helpful suggestions during the study.

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INDICATIONS FOR ROENTGEN THERAPY IN CHRONIC TONSILLITIS AND PHARYNGITIS*

BY W. D. WITHERBEE, M.D.

NEW YORK CITY

THE tonsils and adenoids, as well as the adjacent structures involved in infections of the throat are composed of lymph tissue supported by a fibrous frame work. Lymphoid tissue in its simplest form is defined by Barnes as reticular connective tissue with a greater or lesser number of lymphocytes in its mesh. These lymphocytes cannot be distinguished from those in the blood. The lymphocytes may be scattered diffusely in the reticulum, or may be closely packed within a circumscribed area. The former is the simple or diffuse lymphoid tissue while the latter, in which the reticulum assumes a definite form, is called a lymph follicle. The lymph follicle contains lymphoblasts with mitotic figures of the nuclei, indicating the presence of embryonic tissue.

The changes in the chromatin of the nucleus of the lymphocyte is the first indication of the effect of irradiation. This is followed by degeneration and absorption of the cell which differs in no way from that of any other destructive process. The number of cells affected and the time the process of destruction and absorption takes place, depends on the amount of irradiation absorbed by these tissues. Investigators who have removed tonsils and adenoids some weeks or months after roentgen treatment report that they are unable to find any evidence of active destruction of lymph tissue. The time for such investigation should be when shrinkage and drainage are actually taking place and not after the cells destroyed by the roentgen ray have been absorbed.

Clinically, these same radiosensitive lymph structures play an important rôle in the various forms of leucemia, Hodgkin's disease and lymphosarcoma. The destruction and absorption of these cells with consequent shrinkage of the tumors in these cases is well established. Furthermore the destruction of lymphocytes in the circulating blood as proven by blood counts taken before and after roentgen exposures, indicates that the lymphocytes embedded in the lymph structures involved in infections of the throat may also be destroyed by the roentgen ray. This absorption of lymph elements produces not only a shrinkage from within but promotes eversion and drainage of the infected crypts; quite the reverse of sealing the crypts by the application of caustics to the mucous surface.

Another important factor in the effect of the roentgen ray on infected tissue other than shrinkage and drainage is the biochemical changes produced in the area exposed to irradiation. The results obtained in the past in the various infections of the skin and tuberculous glands, and more recently in diphtheria carriers, erysipelas, acute and sub-acute suppuration in pneumonia, malaria, acute and sub-acute sinusitis, pyorrhea and pertussis indicate that the roentgen ray produces changes in the tissues which interfere materially with the progress of the invading bacteria. This is further emphasized in the results obtained by roentgenotherapy in chronic pharyngitis and tonsillitis in which 80 per cent of those treated have been relieved of this condition, having been under observation for from one to three years.

Some of the cases after receiving roentgen treatment have had their tonsils removed because the examiner has found on culture various forms of pus microorganisms present. The bacterial flora of the throat before and after operation according to Pilot, Pearlmann and Davis remains the same; the only difference being a reduction in the number of the colonies after the operation. Cultures made from throats after roentgen treatment have been free from pathological microorganisms from a few days to several months. Sterilization of the throat is obviously impossible. The washings from the mouth and discharges coming from the nasal fossae are constantly bathing and contaminating these areas. The mere presence of pus bacteria is then no indication for either operation or roentgen treatment except in diphtheria carriers.

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*Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, Jan. 24–26, 1924.

The permanency of roentgen-ray effects on the tissues involved in chronic pharyngitis and tonsillitis has been determined by the examination of the throats of those individuals who have been treated for tuberculous glands of the neck during the past ten years.

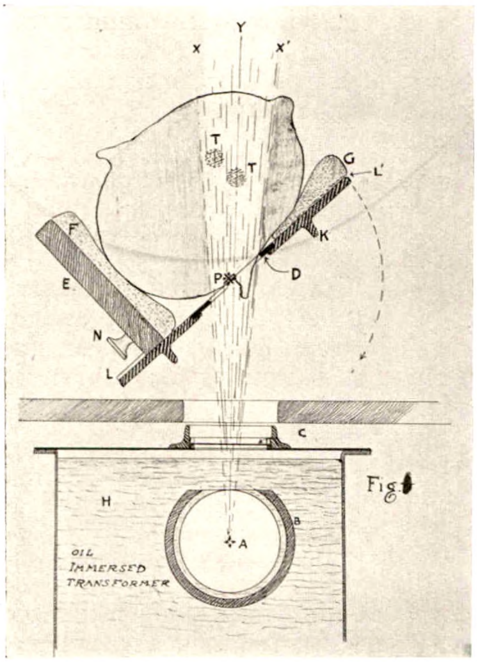

FIG. 1. Diagram showing the roentgen ray directed through the soft parts behind the angle and ramus of the jaw. A is target of the tube, C is filter.

The tissues infected in cases of chronic pharyngitis and tonsillitis are not only the tonsils and adenoids but the lingual tonsil, infratonsillar nodule, lymph nodes on the lateral and posterior walls, lymph tissue in the fossa of Rosenmüller, and the cervical glands. Hence the operation at best removes only part of the tissues involved. Successful results following operations depend not only on the patient's power of endurance to withstand the operation but his ability to overcome the infection remaining in the adjacent structures. This is true of any procedure directed solely to the tonsils and adenoids. A large percentage of patients treated by the roentgen ray give a history of from one to three operations for the relief of this condition.

None of the complications or contraindications in the surgical removal of tonsils and adenoids interfere in any way with the judicious use of roentgen therapy. The improvement noted in some forms of deafness is no doubt due to the relief of pressure on the eustachian tube by the shrinkage of the lymph tissue in the fossa of Rosenmüller.

The shrinkage and drainage of the structures involved in chronic pharyngitis and tonsillitis are dependent on the relative amount of radiosensitive cells and fibrous tissue present. The large soft tonsil reveals the most spectacular results. The small fibroid tonsil containing relatively less radiosensitive tissue and being smaller in size, shows less marked changes. The fibroid tonsil has undergone fibrous degeneration, indicating that the infection is chronic in character and more or less controlled by the fibrous process as exemplified in other forms of infection. This type of tonsil is often embedded in infected tissue and associated with a marked infection of the adjacent structures from which absorption is taking place to a greater extent than from the fibroid tonsil itself. Not all large tonsils are soft—some are firm and fibrous. Neither are all small tonsils fibrous; some are soft

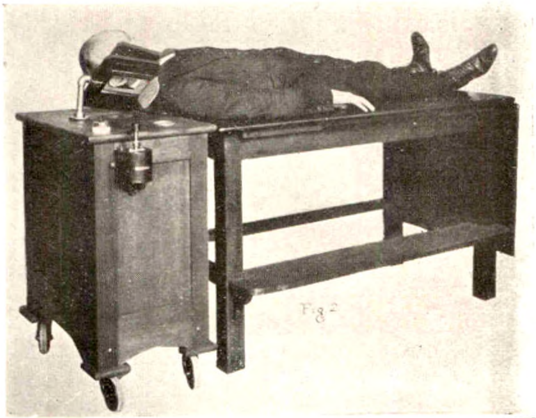

FIG. 2. Patient in position for treatment of left side. Headrest tilted at angle necessary to avoid passing the ray through the angle and ramus of the jaw.

and show marked reduction in size after irradiation.

CONCLUSIONS

Roentgenotherapy given previous to operation materially lessens the amount of dissection necessary for the removal of tonsils, thereby decreasing the possibility of complications.

Roentgenotherapy is recommended in the following cases:

1. Where an anesthetic or operation is contraindicated.

2. Those cases past middle life where hemorrhage may cause complications due to a mild or severe arteriosclerosis.

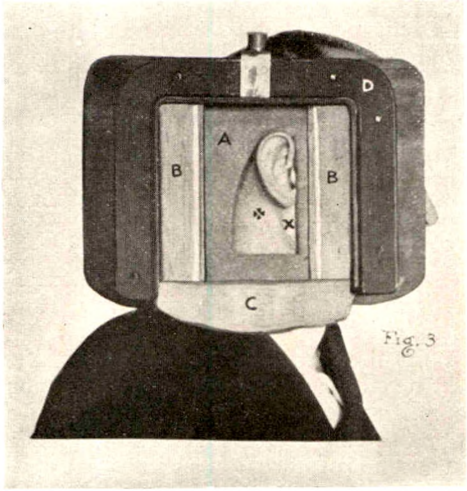

FIG. 3. Area exposed. X is the angle of the jaw; ✠ indicates the point of entry of the central beam.

3. Patients whose tonsils are embedded in infected tissue in which the operation may cause dissemination of septic emboli into the blood and lymph streams, thus producing lung abscess, septicemia, endocarditis, etc.

4. Patients whose adjacent lymphatic structures (not removable by operation) are markedly infected.

5. Patients suffering from chronic cardiac lesions, Bright's disease, diabetes, exophthalmic goitre, chorea, rheumatism, hemophilia, asthma, tuberculosis, status lymphaticus or any condition which has lowered the patient's general resistance.

6. Patients subject to frequent attacks of peritonsillar abscess (quinsy).

7. Vocalists and public speakers subject to frequent attacks of tonsillitis and pharyngitis.

8. Patients suffering from recurrent attacks of pharyngitis after removal of tonsils and adenoids.

Some of the unfavorable results obtained by this method may be accounted for by the fact that the ray was directed through angle and ramus of the jaw instead of through the soft tissues behind the jaw.

The accompanying illustrations show the positions and angles recommended by the writer.

DISCUSSION

DR. GERBER, Providence, R. I. I have felt deeply indebted to Dr. Witherbee from the first presentation of his method. I had the privilege of listening to him when he first publicly brought the method out. Since that time I have followed the modifications and finally settled down to the method as worked out by Witherbee. I was especially pleased today to note the moderation in tone of the entire paper as presented this morning. I am glad to note the feeling that there is to be no hostility nor competition between this method and rational, legitimate nose and throat surgery. I have always felt, and I feel more strongly now after approximately three years of experience, that surgery of the tonsils is by no means going to be eliminated by roentgen-ray treatment; absolutely not. The roentgen ray will have its definite, legitimate, restricted field, and the surgeons will have theirs. It is true that surgery of the tonsil in an adult is dangerous, but much of the danger is due, not so much to the operation, as to the fact that the great majority of tonsil operations are done upon patients who have not had a careful physical examination immediately before the operation, in an effort especially to rule out the presence of recent or acute infections of the upper respiratory tract. Those men who are very careful to see that the patients are in proper condition and postpone their operation if necessary, do not get lung abscesses. Aside from actual tonsillitis, I feel that the tremendous field of roentgenotherapy is to be in the field of adenoids and the rest of the lymphoid ring around the nose and throat; in types of chronic pharyngitis, and especially among the ranks of the great mass of people after middle life who form very poor surgical risks or have contraindications. I want to bring forward one technical feature which I think may be of advantage. In talking over with the nose and throat men the method of treatment, I thought it might be worth while to use the highly filtered homogeneous rays for the tonsil case. We had a case, the second one I have seen, of leptothrix infection of the tonsils, one of the types of mouth fungi that get a firm hold not only on the tonsil but the adjacent structures with very large, white, glistening plaques filling crypts and apparently fastened in the lymph adenoid tissue. It would have been very rash to have attempted to operate. With the patient in the same position that we use in the lighter repeated treatment with the Witherbee method, I employed the 200 kv. highly filtered rays, and gave a sufficient dose in 2 sittings on successive days, one on each side, so that the entire Waldeyer's ring was bathed with approximately a 30 per cent dose. The patient had a very uncomfortable time for one week with swelling and discomfort and hoarseness. At the end of a month the crypt had shrunken, everted and most of the evidence of the leptothrix infection had disappeared. At the end of two months there was practically no evidence of the disease. It looked as if the tonsils had actually been excavated; there was a deep hollow between the pillars different from anything I have ever seen with the older technique. I do not offer that as a substitute for smaller doses repeated, because I believe that it has its advantages in destroying the adenoid tissue and not affecting the normal tissues, but I think it will prove to have a place in certain types of infection of the tonsillar ring.

Dr. Hickey. There is one angle of this question of roentgen treatment of the tonsil which has a geographical importance, I think. In the area immediately around the western part of Lake Erie we have the question of thyroid much more prominently before us than in some other parts of the country, and coincident with that prevalence of thyroid disease we have a very marked prevalence of the enlarged thymus, so much so that no tonsil operation in our part of the country, at least, around Ann Arbor, is undertaken without a preliminary roentgen-ray examination to see if there is an enlarged thymus. At our pathologic conference on Friday afternoon we have very frequently cases presented which have shown acute thymic death. One case which I heard about some two weeks ago, a child perfectly well at eleven o'clock at night, taken with very acute suffocative symptoms, and died before five o'clock the next morning, which was a true thymic death. And so we find that there is more of a tendency to use the roentgen-ray treatment in certain cases of tonsillar enlargement in children than if this question of thymic complication were not present.

Dr. Simpson, Washington, D. C. I think Dr. Witherbee is to be congratulated as a pioneer in this work. I was anxious to hear this paper in the hope that he possibly would have some changes in technique whereby we would improve our results and cut down the number of treatments. I have been interested in comparing the results of roentgen-ray treatment with radium applied directly to the tonsils, and I worked this out in a number of cases of treating one side with the roentgen ray and the other with radium plaques. This radium plaque is an oval shaped arrangement about the size of a lima bean, no angles or corners to it. I give the exposures half an hour on either side. In addition to that I give the Witherbee technique on the other side. There is a remarkable difference in the results of these two treatments. With the radium and the roentgen ray combined we can cut down the number of treatments to, as a rule, three. Sometimes we have to give four, but I do not think I have had a single case where I have had to give five treatments. The average patient can be cleared up in three treatments. My experience with the roentgen ray alone is that only in a minority of the cases can we clean up the fossa sufficiently to satisfy the nose and throat specialist, but this you do accomplish when you apply radium directly to the tonsil. The fossa is empty, possibly a small amount of fibrous tissue down at one end. This pack arrangement that I have been using for two years and a half cannot be applied to all cases; it cannot be applied to children, so that in children I have been using the emanation seeds. In my early cases my seeds were a little stronger than they should have been, they contained more than half a milicurie of emanation. The result was that I had a wound of the tonsil that was very hard to heal. I think it was more an infection than it was actual damage from the radium, but some of these patients developed severe earache, and healing of the wound was very slow. Since then we have been using about a fourth of a milicurie in the tonsils. If the tonsils are unusually large, put two seeds in it; be sure that your seed is surrounded by at least three quarters of a centimeter of tonsil in order to keep the ray from the pillar. In refractory and young children, this is a very easy method of treatment, but for adults, the pack is the treatment, combined with the roentgen ray. I have had a number of cases where I used the roentgen ray alone on one side and the two combined on the other side, and one treatment of the combined method approximately represents four or five treatments with the roentgen ray. I have come to the conclusion that with the combined pack and roentgen ray I can cut down the number of treatments to half and really get a better result in the end than I can with the roentgen ray alone.

Dr. Grier, Pittsburgh, Pa. I have treated several tonsil cases by the application of radium outside. I have not heard anybody say anything about this. The results seemed to me to be about the same as in the treatment with the roentgen ray. I would like to ask Dr. Witherbee whether he has had any experience with radium applied externally and if he knows any objection to it?

Dr. Witherbee (closing). In regard to radium, I know very little about the application of radium, but it seems to me this point might be raised, that there is a possibility of radium having some effect on the pituitary gland; one lobe of the pituitary is lymphatic, and I feel that we can direct the roentgen ray well in front of that without raising that question at all. So far as the small doses are concerned, and the number, I feel that if you can do your work without causing the patient any discomfort, and allow the changes in the other structures in the throat to take place gradually, you get much better results in the end and the patient will feel more gratified. So far as deep therapy is concerned, I should feel a little bit the same as I would about radium. I believe one of the points made in the discussion was that it is not so much the amount of shrinkage or the number of bacteria you can get out of the throat, as it is the general condition of the patient and the freedom from the recurrent attacks of tonsillitis and pharyngitis. This is quite evident in those cases that have been operated upon. I think that the immunity produced is well illustrated in the various other infections treated by the roentgen ray. Of course any one who follows a technique and has a rigid rule of so many treatments for each case and then waits until some of them come back, and does not follow them up, is going to have more cases that require to be operated on than would happen where they are more carefully looked after. I make it a rule to wait two months after the eighth treatment and examine them again, and if necessary give them two more treatments and have them come back for a year or two afterwards occasionally if they have any trouble.

A CASE OF MELANOSARCOMA TREATED WITH ROENTGEN RAYS*

BY ARTHUR K. OWEN, M.D.

TOPEKA, KANSAS

A DESCRIPTION of this case is as follows:

Female, aged fifty-nine.

Family History. Negative.

Present Illness. In June, 1919, a small mole that had always been present on the anterior surface of the right forearm began slowly to enlarge and to become slightly painful. In September, 1919, the patient consulted a physician who cut off the top of the mole with a pair of scissors. The growth gradually recurred, however, and in December, 1919, she consulted another physician who put some kind of salve on it. This did not destroy it, for in five or six weeks it began enlarging again. In February, 1920, her physician tried to remove it by tying it off with a fine wire. This caused profuse hemorrhage and removed only the top of the tumor, which began immediately to enlarge from the base. In April and May of 1920, cautery and fulguration were tried, but without any benefit, as the tumor rapidly increased in size. In the latter part of June, 1920, her physician consulted with a surgeon who made the diagnosis of melanosarcoma and suggested that the arm be amputated at the shoulder, but held out no hope that the operation would give much relief. The operation was refused and the patient was referred to me on July 1, 1920.

The tumor at this time was of a dense black color situated in the mid-part of the anterior aspect of the right forearm. It was 4 cm. long, 3 cm. wide and was elevated 3 cm. above the skin surface. On the posterior aspect of the forearm and 5 cm. mesial to the primary tumor,

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* Presented with application for membership in The American Roentgenology Ray Society, 1922.

were three smaller tumors situated deeply beneath the skin, all three jet black in color and easily palpated. There was a tumor in the right axilla the size of a large hen egg.

Treatment. On three successive days, July 1, 2 and 3, 1920, the patient received a half-hour of unfiltered *x*-rays over the tumor mass, a total of one and a half hours in the three days. A 10-in. spark-gap measured between blunt points, 5 ma. of current and a 10-in. target-skin distance were used. The tumor was exposed through an opening in sheet lead which extended ½ cm. beyond the margin of the tumor. On the same three days, the entire arm from the wrist up, the axilla, the shoulder and the right chest received an hour each day of filtered *x*-rays, a total of three hours in the three days, a 10-in. spark-gap, 5 ma., 14-in. target-skin distance 6 mm. of aluminum and 5 mm. of leather being used for a filter. Each skin area received thirty minutes. She reported back in August, 1920: at this time the elevation of the tumor was reduced while its circumference was slightly increased. She received another half-hour of unfiltered *x*-rays (10 in. sp. g., 5 ma., 10-in. target-skin) over the tumor, and one and one half hours of filtered (6 mm. Al. 5 mm. leather) *x*-rays over the arm, axilla and chest, with a target-skin distance of 14 in. This same dose, a half-hour unfiltered, and one and a half hours filtered over the arm, shoulder and chest, was repeated in September, October and November, 1920. At the November treatment the site of the original tumor was occupied by a depressed ulcer. The axillary enlargement was very much smaller.

The patient did not return to me until February of 1921, after an absence of over two months. At this time the site of the original tumor had largely healed in a depressed scar, in the bottom of which was a considerable amount of black pigment. The three smaller metastases on the opposite side of the arm could be seen as three areas of black pigmentation, but they could scarcely be palpated. The tumor in the axilla was entirely gone. She received three more treatments, all filtered as above, the last being given April 28, 1921. At this time treatment was discontinued and the patient was asked to report back every three months for observation.

She has made her third such return, and now, January, 1922, still remains free from her former trouble. The depressed scar at the site of the original tumor is entirely healed, but still contains the black pigment in its base. The three smaller tumors on the opposite side can still clearly be seen as three areas of black pigmentation, but they cannot be palpated. The axilla is still entirely clear. In September, 1921, an examination of the chest showed both lungs clear. Now, nineteen months after beginning treatment, all signs of the tumors have disappeared and the patient is perfectly well.

Note made Aug. 24, 1923. The patient was in this afternoon, three years and twenty-four days after initial treatment. The site of the original tumor is still a depressed scar, in the bottom of which are several areas of black pigmentation. The three metastases on the posterior surface of the forearm are still to be seen as three areas of pigmentation, but there has been no change in their size in the three years. The skin on both the anterior and posterior surfaces of the forearm contains a number of small petechiae, as does also the skin about the axilla. The axilla is clear.

The doctor who referred this patient to us had a series of slides of the tumor made and the pathological report of them was melanosarcoma.

Résumé of Treatment. A half-hour on three successive days of unfiltered *x*-rays over the tumor mass, using a 10-in. gap between blunt points, 5 ma. of current and a target-skin distance of 10 in.

A half-hour of unfiltered *x*-rays over the tumor area repeated once each month for four months (10 in. sp. g., 5 ma., 10 in. target-skin distance), making a total of three and one-half hours of unfiltered *x*-rays in five months.

Thirteen and a half hours of filtered *x*-rays using a 10 in. gap, 5 ma. current, 14 in. target-skin distance, with 6 mm. of aluminum and 5 mm. of leather as a filter, given in eight months over arm, axilla and chest.

MASSIVE COLLAPSE OF THE LUNGS

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DEFINITION

TOTAL or partial collapse of the lung occurring particularly after operations and injuries, and characterized by dyspnea, dulness over the involved area and marked displacement of the heart and mediastinal contents to the affected side.

SYMPTOMS

Massive collapse of the lung occurs in two forms, the latent and the acute. In the latent form there are no symptoms, the condition being recognized by the physical signs and the typical roentgenogram. The acute form, however, comes on very suddenly, the onset often being of such suddenness as to suggest pulmonary embolism, acute pneumothorax, or even sudden heart-failure. The first symptom is usually severe dyspnea, the respirations being very short and greatly accelerated. The shortness of breath is very urgent, and even the slightest exertion increases it markedly.

This sudden onset may be preceded, in some cases, by a period of a few hours in which the patient complains of vague pains, or rather, an uneasy feeling in the chest; a rising temperature has been observed during this premonitory period.

Cough may be absent at first. After the first few days, however, there is a productive cough with much thin, watery sputum. The sputum may be mucopurulent and have a slightly offensive odor; it may, very rarely, be rusty. Pain is not a common symptom; if present, it is not severe and lasts but a short time.

The temperature is moderately elevated, 101° or 102°F. being the rule. The rise in these instances has been compared to that seen in pulmonary embolism. The pulse is rapid, the increase in rate being proportional to the temperature rise. If the temperature rises to 104° or 105°F., pneumonia or other complication should be suspected.

SIGNS

The patient is cyanotic and in obvious respiratory distress. The affected side is retracted and moves but slightly or not at all with respiration. There is marked dulness or flatness over the involved area. If the collapse is on the left side, there may be resonance to an unusually high level in the left axilla because of the elevation of the diaphragm. Tactile and vocal fremitus may be diminished or absent; more commonly, they are increased, with bronchophony and pectoriloquy. In the beginning there are few or no rales; after the first few days, rales become very profuse.

The heart and mediastinal contents are markedly displaced to the affected side. The cardiac impulse may be in the left axilla or in the right nipple line. The heart is displaced both laterally and upward. This sign is typical of massive collapse; if the collapse is bilateral, however, there may be little or no displacement of the heart.

ROENTGEN EXAMINATION

The involved portion of the lung shows diminished radiance. The dulness is usually of a somewhat mottled character and of about the same density as the heart shadow. The diaphragm on this side is high and motionless. If the lower lobe is involved, the shadow of the diaphragm merges with the dulness of the collapsed area and is obliterated, or seen but very indistinctly. It is possible, when the process involves the left lower lobe, to demonstrate the elevation and fixation of the diaphragm by inflating the stomach with gas. The heart and trachea are markedly displaced to the affected side. The uninvolved side appears unusually bright, the interspaces on this side being widened, and the diaphragmatic excursions are greater than normal.

ETIOLOGY

The causes of massive collapse of the lung are diphtheritic paralysis of the diaphragm, gunshot wounds, injuries and abdominal operations. Operations for appendicitis and hernia are among the most common causes. Collapse has been seen after operations on all parts of the abdomen, with all anesthetics, and even with no anesthetic. Bradford reports massive collapse after fracture of the pelvis or femur; with wounds of the buttocks, thighs, or abdomen; and in gunshot wounds of the chest. Even a non-penetrating wound of the chest with no fracture of the ribs and no smashing of the chest wall has been followed by collapse of a whole lung. After an injury, be it slight or severe, the collapse may involve the lung on the same side, the opposite side, or may even be bilateral. There may be collapse of one or more lobes on the same or both sides.

The onset is usually within the first twenty-four hours after the exciting trauma, though it may be delayed for several days. The duration, similarly, varies from a few days to three weeks.

The mechanism of the collapse has not yet been agreed on. Pasteur believed that reflex inhibition of the movements of the diaphragm or paralysis of the muscles which are the direct distenders of the lungs, i.e., the diaphragm and the intercostals, as in diphtheritic neuritis, was the cause of the collapse.

Quoting from Fox, he classifies the causes of collapse of the lung as follows:

1. Congenital non-expansion.
2. Obstruction of the bronchial tubes.
3. Pressure on the lungs by fluid or solids.
4. Pneumothorax.
5. Imperfect power of expanding the thorax.

It was his opinion that the paralysis of the diaphragm, by causing imperfect power of expansion of the thorax (5) acted as a deflating force which compressed and emptied the lung of air without there being any bronchial obstruction, thus causing an "active" collapse. The recumbent position and deficient respirations during operations and after injuries have been advanced as probable causes of the fixation of the diaphragm; also, involvement of the diaphragm in peritonitis has been thought to cause inadequate respirations.

Another theory to explain this phenomenon was that the immobility of the diaphragm allowed secretions to block the bronchioles and that the collapse ensued as a consequence of this blockage. Lichtheim in 1878 had produced collapse experimentally in rabbits. Without opening the thorax, he inserted a laminaria plug into the bronchus, so that air could neither enter nor leave that portion of the lung; as a result, the air in this region was absorbed into the blood, the involved area collapsed, and the heart and mediastinal contents were displaced to the affected side. This collapse did not take place if the blood-vessels to the lung were tied. In this case the collapse was "passive," as against the "active" collapse of Pasteur.

Bradford finds it difficult to accept either of these theories. Thus, there often is no post-mortem evidence of bronchial obstruction, and it does not appear probable that a comparatively trivial injury of one side of the chest should cause paralysis of the muscles of respiration on the opposite side. Hirschboeck, one of the latest to write on this subject, states his belief as follows: "Bronchial obstruction and muscular immobility tend to bring about this condition, the one factor or the other predominating in the individual case, leading to alveolar absorption and massive collapse." This appears to be the most likely explanation at the present time.

PATHOLOGY

The involved portion of the lung is blue or violet in color and sharply demarcated from the normal lung tissue. It is soft, tough and wet; it feels heavy, does not crepitate, and sinks when placed in water. Microscopically, the alveolar surfaces are closely approximated, the alveolar spaces being obliterated.

TREATMENT

Preventive measures would, undoubtedly, reduce the incidence of massive collapse. During operations and after injuries, the respiratory movements should be unhampered. The early use of antitoxin has practically eliminated the cases which come on after diphtheritic paralysis of the diaphragm. During the period of respiratory distress at the time of the acute onset of the attack, there are no measures which will afford relief, though oxygen inhalations may be of value in very severe cases. After the acute stage has passed, deep breathing exercises and blowing into a bottle are believed to expedite the re-expansion of the lung.

REVIEW OF LITERATURE

Pearson-Irvine[1] in 1876 described a condition clinically similar to massive collapse and thought it was due to the paralysis of the muscles concerned in the elevation of the upper part of the thorax. Two years later, Lichtheim[2] produced collapse experimentally in rabbits by plugging the bronchus; the air thus imprisoned in the lung was absorbed into the blood stream and collapse of the involved area resulted. In 1890, Pasteur[3] reported 34 cases of massive collapse of the lung occurring in patients with diphtheritic paralysis of the diaphragm. He was the first to identify this condition as a clinical entity and he applied to it the name "massive collapse of the lung." In 1908 he delivered the Bradshaw lecture,[4] choosing massive collapse as his subject. He believed that the collapse was generally caused by paralysis of the diaphragm and intercostal muscles; and that reflex inhibition of the diaphragmatic movements might lead to the same result. In his last paper in 1914,[5] he reported 16 cases which had occurred after 2,000 abdominal operations; in this group of 2,000 cases, there had been a total of 65 postoperative pulmonary complications.

A few months after the appearance of Pasteur's paper in 1914, Elliot & Dingley[6] reported 11 cases of massive collapse. These had occurred during a period of two years and all had followed abdominal operations such as appendix, gall-bladder, gastroenterostomy and hernia. They advanced the theory that the immobility of the diaphragm allowed secretions to block the bronchioles and that collapse then ensued. In 1918, Crymble[7] reported several cases occurring after gun shot wounds.

Bradford[8] in 1920 published a very complete paper on this subject. He finds it difficult to accept either of the theories already advanced. He states: "There is often no clinical or post-mortem evidence of bronchial obstruction, and it is particularly difficult to explain the frequent absence of symptoms if the obstruction is of bronchial origin. On the other hand, it is not easy to understand why a comparatively trivial injury of one side of the chest should cause a reflex palsy of the respiratory muscles on the opposite side; but on the whole, it would seem that this explanation is the more probable."

Briscoe,[9] also in 1920, published a paper entitled "The Mechanism of Post-operative Massive Collapse of the Lungs." He states: "The phenomena of the post-operative massive collapse attack are produced by the onset of inflammation affecting the muscles of the crus situated behind the peritoneum. My contention is that one-half of the diaphragm and its synergic and antagonistic muscles are out of action owing to inflammation of the muscle or of the pleural membrane covering it."

In 1921, Scrimmger,[10] reported 7 cases occurring in a series of 540 consecutive operations over a period of one year. Other papers on massive collapse have appeared during the past two years by various authors, among whom may be mentioned Scholtz,[11] Elwyn and Girsdansky,[12] and Hirschboeck.[13]

REPORT OF CASE

Male, white, aged twenty-eight, a laborer by occupation. Entered the hospital for relief of adhesions following an operation for appendicitis.

Past History. Nine years ago he had an operation for the repair of bilateral femoral hernia, and made a normal convalescence. About a year and a half ago he was operated upon for appendicitis. The wound was drained for a week, and then healed slowly. One year ago he was operated upon for an inguinal hernia; both the operation and convalescence were uneventful. Remainder of past history unimportant.

Present Illness. Ever since the appendectomy with drainage about one year and a half ago, he has had pain in the lower right quadrant. There is a dull ache almost constantly in this region; and on straining or exertion, it becomes a sharp, nonradiating pain. He has some nausea, but never vomits. Bowels move regularly. Appetite is good. There has been no loss of weight and no night sweats, cough, or sputum.

Physical Examination. A well-developed and nourished, rather thin young man. The heart and lungs are entirely negative. The abdomen is soft. The right rectus incision appears thickened and there is marked tenderness over it. The scars of the other operations are firm and painless.

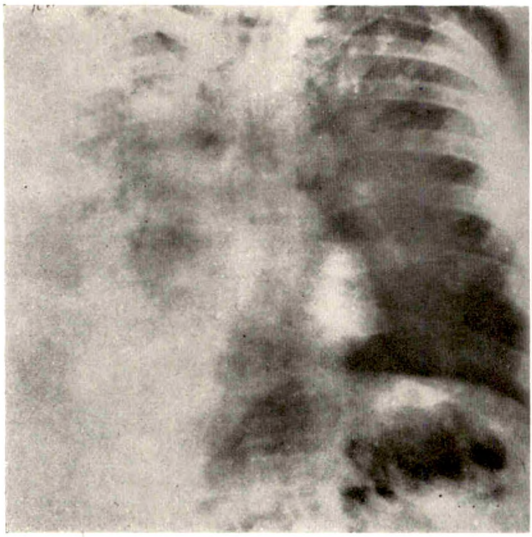

FIG. 1. Massive collapse of the right lung. Shows the marked displacement of the heart and trachea to the affected side.

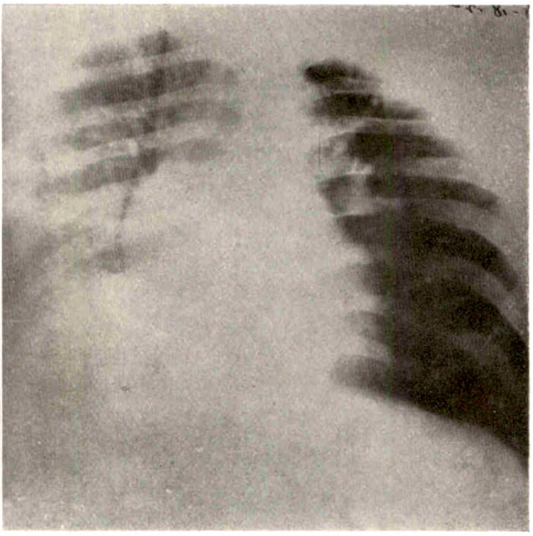

FIG. 2. Same, five days later. The right lung is beginning to clear. The heart and trachea are still markedly displaced to the right side.

A diagnosis of ventral adhesions in the right rectus scar was made and lysis of the adhesions decided on.

During the three days which the patient spent in the hospital prior to operation, his temperature was 98.0° to 98.6°F., pulse 76–80 and respirations 20.

Operation. Morphine and atropine were given preliminary to operation. His preoperative condition was reported as good. Gas-ether anesthesia was used, the operation lasting fifty-eight minutes. There was no shock or other apparent complication and the patient arrived on the ward in good condition.

The evening following the operation, he felt comfortable, temperature being 99.6°F., pulse 74, respirations 20. The following morning, he suddenly complained of shortness of breath and a feeling of tightness across the chest. There was a sudden sharp temperature rise to 102.0°F.; the pulse rose to 105, and respirations to 30. He had a slight cough and raised a moderate amount of thin, yellowish sputum.

Physical examination showed diminished excursion of the right chest. There was dulness and bronchial breathing over the entire right side. The left chest was hyperresonant. The cardiac dulness and heart sounds were displaced markedly to the right. No rales were heard at first; after the third day, however, numerous fine rales appeared. The white count was 11,400.

During the first five days, the patient's condition remained essentially unchanged. *X*-ray examination at this time (Fig. 1) showed markedly diminished radiance over the entire right lung-field. This dulness was of a mottled character in its upper portion, becoming more uniform and of a greater degree of density as it approached the base. The right border of the heart and the right diaphragm merged with this dulness and were obliterated. The trachea was displaced markedly to the right, its outline being distinctly visible to the right of the sternum. The heart, also, was markedly displaced to the right, the left cardiac border being near the left sternal edge. The left lung-field was unusually bright and the interspaces on this side were widened. The left diaphragm was normal in contour and position; its respiratory excursions were increased.

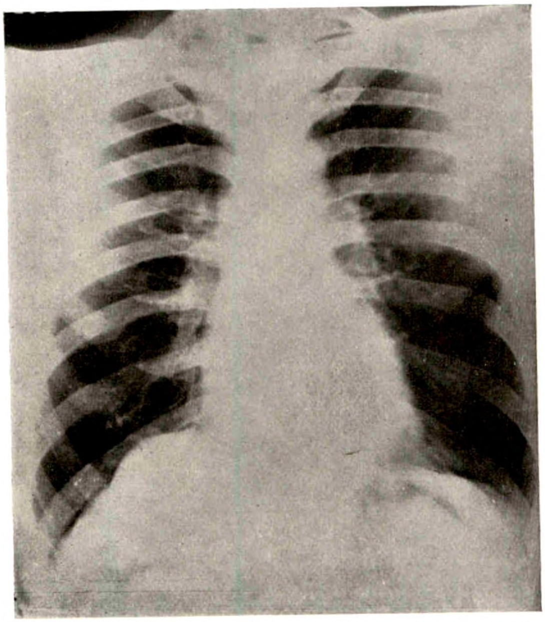

FIG. 3. Same, four months later. There is no deviation from the normal in the lung fields.

On the basis of the clinical findings and the roentgen examination, a diagnosis of massive collapse of the right lung was made.

On the sixth day after operation, temperature was 101.2°F., pulse 94, respirations 25; on the following day, the temperature was 98.8°F., pulse 85, respirations 25, and the patient was markedly improved clinically with much less cough. *X*-ray examination at this time (Fig. 2) also showed a marked change for the better. There was still diminished radiance over the entire right side, but it was much more mottled in character and there was evidence of beginning expansion of the lung. The heart and trachea were displaced to the right, but much less so than at the first observation. The right diaphragm could be seen faintly; it appeared high and its respiratory excursions were markedly limited. On the left, the findings were practically unchanged.

The patient continued to improve. On the eighth day after operation, temperature was 98.8°F., pulse 90, respirations 22; three days later, temperature, pulse and respirations were normal, there was no cough and he felt perfectly comfortable; at this time, the lung had apparently expanded and the heart and trachea had resumed their normal positions.

About four months later, the patient was requested to return for examination. His chest was examined carefully by two clinicians and found to be entirely negative. *X*-ray examination of the chest (Fig. 3) showed no deviation from the normal in the lung-fields, diaphragm, heart, or the position of the trachea.

COMMENT

This discussion and report of a case of massive collapse of the lung have been presented, not merely because of the comparative rarity of this condition, but rather because of their interest and importance to the surgeon, the clinician and the roentgenologist. The surgeon should be aware of the possibility of massive collapse so that he may realize that he is not dealing with a postoperative pneumonia, embolism, or similar serious complication. Massive collapse is rarely fatal, the prognosis being good except in cases with very extensive bilateral collapse, or those in which severe sepsis sets in. Since the clinician is frequently called in consultation in cases of pulmonary complications after operation, he must always bear in mind the possibility of massive collapse. As Bradford emphasizes so strongly, this condition has been confused with pneumonia, cardiac disease and other pulmonary or pleural lesions such as abscess of the lung; and such erroneous diagnosis may lead to methods of treatment which are not only unnecessary, but sometimes positively dangerous to the welfare of the patient; as for example, exploratory thoracotomy. The roentgenologist, too, should be on the watch for cases of massive collapse, for the *x*-ray picture is so typical that an erroneous diagnosis on his part is hardly excusable.

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THE EFFECT OF X-RAYS ON BONE MARROW*

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THE action of *x*-rays on bone marrow was undertaken experimentally as part of an investigation started by two of us to determine whether certain chemical and physical agents have the property of stimulating bone marrow. Through the use of intra-vitam bone-marrow puncture as described by Morris and Falconer[1] it is possible to secure fresh specimens of bone marrow from the living animal and to study directly the effect of chemical and physical agents on the marrow. Such direct study is satisfactory within certain limits and enables one to make repeated observations, at stated intervals, on the same animal.

We were unable to find any published accounts with definite experimental evidence as to whether or not *x*-rays are capable of stimulating bone marrow. Considerable experimental work has been done on the effect of *x*-rays on the developing ovum and embryo. The earlier experiments were performed by Perthes[2] who found that exposure of the ova of Ascaris megalocephala to *x*-rays resulted in delayed development and the production of abnormal forms. In 1904 Gilman and Baetjer[3] observed temporary stimulation after radiating the ova of Amblyomma but the result was a fairly constant type of developmental defect. Bordier[4] in 1905, exposed young larvae of the common silk-worm to *x*-rays and found inhibitory effects in their development. Later work is that of Colwell, Gladstone and Wakeley,[5] who observed the action of repeated doses of *x*-rays upon the developing chick embryo. They conclude that embryos irradiated immediately before incubation and then subjected to daily exposures for several days were invariably smaller than the controls. The effects seemed to depend on the total amount of radiation reaching the embryo rather than upon its quality or "hardness." Some of their experiments seemed to indicate that embryos allowed to develop normally for ninety hours, then exposed to *x*-rays for three successive days, produced, in some cases, a certain degree of stimulation, as indicated by a slight increase in size. We have been interested in the studies of Ivy, Orndoff, Jacoby and Whitlow[6] on the effect of *x*-rays on glandular activity. Broadly stated, their results indicate that small doses of *x*-rays do not stimulate or sensitize the submaxillary gland to increased secretion. They also found that large doses of *x*-rays cause an immediate depression of the secretory activity of the gland, which they state may be due to an altered blood flow through the gland.

These experiments bear on our problem only in so far as there may be a similarity between rapidly growing embryonic cells whose chief function is to proliferate and the cells of the bone marrow which have a like function. We know, however, that other agents besides *x*-rays will produce arrest of development and abnormal types in the embryo. Abnormal temperature changes, treatment by many chemicals, lack of oxygen supply, or too much carbon dioxide, nutritional changes induced by feeding of thyroid gland and pituitary gland substances, all may produce marked changes in the developing embryo. We do not know what the effect of these agents is on normal adult bone marrow, but it seems, reasoning from analogy, that agents causing retardation or acceleration of division and growth of embryonic tissue, might similarly affect bone marrow, a tissue which probably retains its embryonic property of division and rapid growth.

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* Read at the Twenty-fourth Annual Meeting of The American Roentgen Ray Society, Chicago, Ill., Sept. 18–21, 1923.

One question of importance in this study is whether or not it is possible to supply a stimulus to increased marrow cell production, other than the physiological stimulus of a need for more cells, such as comes from blood loss or blood-cell destruction. There are physical and chemical agents capable of irritating and destroying bone-marrow cells, as is seen in benzol poisoning and with radium emanation, when applied in close approximation to bone marrow. The specific points which these experiments seek to furnish data on are:

1. Will small doses of *x*-rays applied locally over a bone irritate the contained marrow cells and cause division and proliferation to proceed at a rate beyond normal?

2. Will large doses of *x*-rays applied locally over a long bone cause the contained marrow cells to undergo necrobiotic changes with resultant depression of the function of division and proliferation so that less than the normal number of marrow cells will be present on examination, or will a normal marrow become replaced by a fatty, atrophic, marrow tissue?

3. Is it possible indirectly to influence or to stimulate the bone marrow to an increased production of marrow cells by applying *x*-rays over the spleen?

Our first experiments were performed on rabbits (large rabbits being selected). A large dose of *x*-rays was applied over the front leg, on the right side, with a small dose applied to the hind leg of the same side. The left front and hind legs were used as controls. These experiments were unsuccessful and fell short of their purpose for two reasons. First, it was impossible to perform repeated marrow punctures at frequent intervals, over a long period, without fracturing the bones punctured. Second, when the animals were sacrificed and the marrow examined, the long bones were found to be so markedly and uniformly cellular that it was impossible to judge with precision fine degrees of increased or diminished cellular activity.

Our subsequent experiments were performed on dogs of fair size and development, as the long bones of these animals are sparsely cellular and a fairly satisfac-

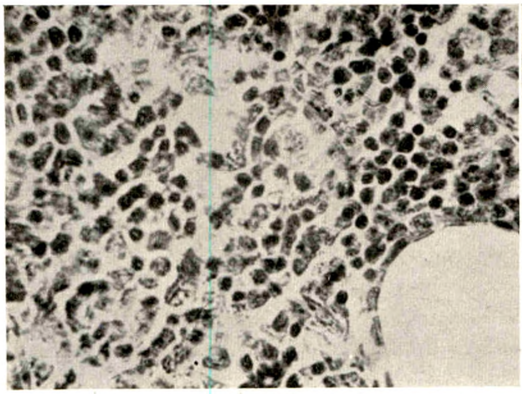

FIG. 1. Portion of left rib one week after heavy dosage of *x*-rays (control side).

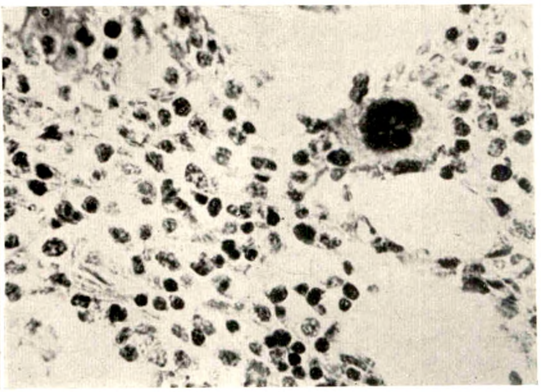

FIG. 2. Portion of right rib one week after heavy dosage of *x*-rays (radiated side). Difference in appearance between Figures 1 and 2 is due to the fact that sparsely cellular fields were selected for these microphotographs.

tory base line can be secured. The setting for the experiments was as follows:

Two dogs were used, one, designated as Dog 2244, an old male, lively and apparently healthy. The other, designated as Dog 1, was a young female, rather thin at the beginning of the experiments, and for some reason showing a fairly marked secondary anemia. The cause of this anemia we did not discover as we knew nothing of her antecedents. We felt that she was a good subject for our purposes, as her marrow was active and in a state that should easily respond to a marrow stimulus. These dogs were kept in cages and fed on table scraps. As the experiments progressed, the diet contained an increasingly larger proportion of meat. The *x*-ray treatments were localized as nearly as possible over the humerus, where the designation front leg is used, and over the tibia and femur, where the designation hind leg is used. The marrow punctures were performed for the most part on the tibia, though a few were performed on the femur. When the front leg was the site of a marrow puncture, the humerus was used. Technique used for accomplishing marrow puncture is described by Morris and Falconer in the *Archives of Internal Medicine*, October, 1922, xxx, 485. The marrow obtained from the punctures was smeared uniformly on cover slips, which were then dropped into absolute methyl alcohol and stained by a combination, Jenner stain, counter-stained by Giemsa's stain. The smears were rather difficult to interpret as we had to adopt criteria for estimating increased or decreased marrow activity. These criteria were evolved from examining many marrow smears from normal dogs, and from dogs with rickets, in which the marrow is hyperplastic. In the end, we adopted two main standards to guide us in estimating marrow activity and lack of activity.

Chart No. 1. Experiment No. 1.

Days before and after X ray treatment.	Heavy Dosage X-ray Right Front Leg.				Control. Left Front Leg.				Light Dosage X-ray Right Hind Leg.				Control. Left Hind Leg.			
	Cells per field	White Cell Series.	Red Cell Series.	Marrow Cell Series	Cells per field.	White Cell Series.	Red Cell Series.	Marrow Cell Series	Cells per field	White Cell Series.	Red Cell Series.	Marrow Cell Series.	Cells per field.	White Cell Series	Red Cell Series	Marrow Cell Series
3 days before	2-3	55	28	17	3-5	49	27	24	3-5	51	29	20	2-4	49	26	25
2 days after.	3-5	55	26	19	2-3	52	28	20	3-6	49	33	18	6-10	39	43	18
9 days after.	3-5	51	26	23	2-5	51	29	20	4-7	47	28	25	6-9	43	36	21
21 days after.	2-4	53	28	19	3-4	52	27	21	3-5	49	28	23	5-8	47	30	23

These are the average number of cells per field, picking out in each smear the best fields, and the types of cells present in each smear. As to types of cells, we have roughly divided them in each smear into White Cell Series, Red Cell Series and Marrow Cell Series. Differential counts have been made on each marrow specimen, according to this classification. In the White Cell Series are included chiefly cells having from 3 to 6 and 7 lobes of the nucleus and resembling the polymorphonuclear neutrophile of the peripheral blood in possessing neutrophilic granular cytoplasm. These proved fairly easy to identify. The Red Cell Series include those cells with dark, basophilic cytoplasm, occasionally reddish tinted, with dark staining round nuclei. The smaller nuclei usually stain as a dense black or dark bluish mass, while

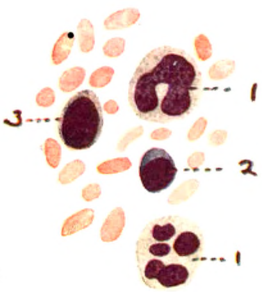

FIG. 1—Dog 26. December 8, 1922. Young normal dog. Bone marrow smear shows 2 to 3 cells to the field.

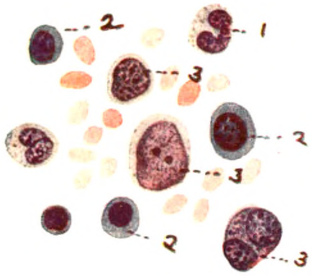

FIG. 2—Dog 33. December 6, 1922. Hyperplastic bone marrow from a young dog with Rickets.

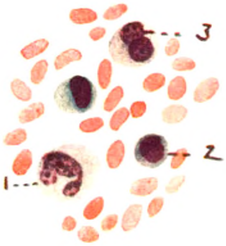

FIG. 3—Dog 2244. December 6, 1922. Right Tibia, before any exposure to X-ray had been attempted.

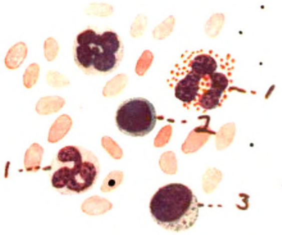

FIG. 4—Dog 2244. December 17, 1922. Right Humerus, treated side, nine days after heavy dose of X-ray.

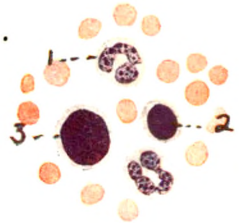

FIG. 5—Dog 2244. December 17, 1922. Right Tibia, treated side 9 days after light dose of X ray.

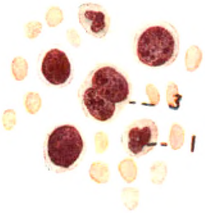

FIG. 6—Dog 1. July 9, 1923. Right Tibia, exposed side During repeated exposure to small doses of X-ray.

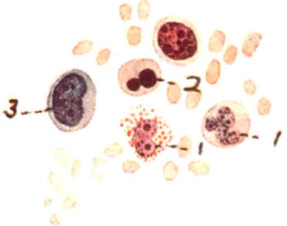

FIG. 7—Dog 1. July 9, 1923. Left Tibia, control. During repeated exposure to small doses of X-ray.

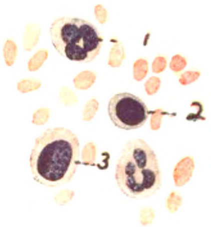

FIG. 8—Dog 2244. March 1, 1923. Left Tibia before X-ray exposure over spleen.

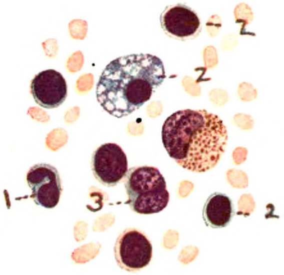

FIG. 9—Dog 2244. March 15, 1923. Right Tibia, 12 days after exposure of spleen to X-ray.

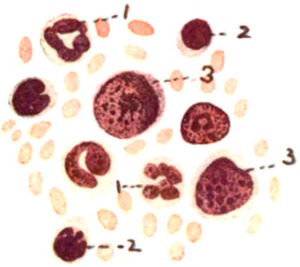

FIG. 10—Dog 2244. April 21, 1923. Right Tibia, smear taken during course of exposure over spleen. (weekly small dosage of X-ray).

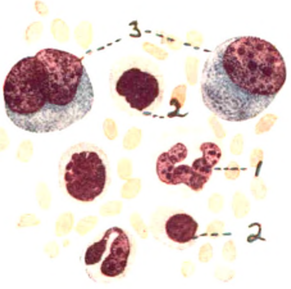

FIG. 11—Dog 2244. May 19, 1923. Left Tibia, 9 days after last exposure of spleen to X-ray (light dosage).

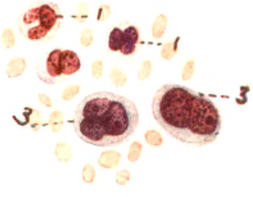

FIG. 12—Dog 2244. June 16, 1923. Left Tibia, 35 days after last exposure of spleen to X-ray (light dosage).

1. *White cell series.*
2. *Red cell series.*
3. *Marrow cell series.*

Drawings by Ralph Sweet

the larger nuclei exhibit masses of dark staining chromatin bunched around the periphery, the center of the nucleus being more open, with fine interlacing strands of chromatin running through. Some of these larger nuclei closely resemble rosettes. The marrow cell series include the larger cells with large round or oval nuclei "open-faced," with knots and bunches of chromatin scattered through, and varying amounts of pale blue homogeneous cytoplasm. Many of these cells show what appears to be direct division of the nucleus into two and sometimes three distinct nuclei. Cells of this type with granules in the cytoplasm were classed under the White Cell Series. These marrow cells are very interesting and merit a much fuller description, which cannot, however, be attempted in this communication.

Chart No. 1 Experiment No. 2.

	Irradiated Leg. Right Hind Leg.				Control Leg. Left Hind Leg.			
	Cells per Field	White Cell Series	Red Cell Series	Marrow Cell Series	Cells per Field.	White Cell Series	Red Cell Series	Marrow Cell Series
Before treatment.	8-10	25	40	25	10-12	27	40	33
5 days after.	7-10	34	32	34	8-10	20	53	27
12 days after.	7-8	48	26	26	8-10	30	31	39
18 days after.	6-8	47	34	19	8-10	45	35	20
26 days after.	5-7	51	33	16	6-9	55	30	15
40 days after.	3-5	45	30	25	8-12	40	32	28
46 days after.	5-8	60	20	20	6-9	55	28	17
60 days after.	5-6	55	25	20	6-8	50	21	29
75 days after.	3-5	55	24	21	8-10	58	22	20
92 days after.	3-5	54	20	26	6-9	50	30	20

EXPERIMENT NO. I

Exposure of Long Bones to Large and Small Doses of X-rays, in the Same Animal

Dog 2244. Preliminary blood counts were made on Dec. 1, 1922 and on Dec. 5, 1922. A bone-marrow puncture was performed on right and left front legs (humerus) and on right and left hind legs (tibia). On Dec. 8, 1922, *x*-ray exposures were made as follows:

	Distance in.	Filter Aluminum mm.	Milliampere min.
Right front leg (inner aspect, over humerus)....	12	9	250
Right hind leg (inner aspect, tibia and femur)..	12	9	50

The left front leg and left hind leg were carefully screened and used as controls.

We attempted in this experiment to ascertain the immediate effects of exposure of the marrow of long bones to both large and small doses of *x*-rays. The only portion of the marrow showing an increased number of cells in the smears obtained was the left hind leg, the control side for the limb receiving the small dose of *x*-rays. We have no satisfactory explanation for this. The point will be discussed later. Blood counts during the period of this experiment are shown in Chart No. 6. As will be noted, there was no difference between the effects of the light and heavy dosage, neither exposure seeming to influence the number of cells present.

EXPERIMENT NO. 2

The Immediate and Remote Effects on the Marrow of a Heavy Dose of X-rays over a Long Bone

Dog 1. On Dec. 30, 1922, a blood count was made and a marrow puncture performed on right and left front legs and right and left hind legs. The right front leg (humerus) showed 2–3 cells per field and left front leg (humerus) showed 3–6 cells per field. The front legs were not used again during the remainder of the experiment, the left hind leg alone serving as the control. On Jan. 9, 1923, the following *x*-ray exposure was given over right tibia, inner aspect.

	Distance in.	Filter Aluminum mm.	Milliampere min.
Right hind leg......	12	9	480

At the beginning of this experiment, the bone marrow of this dog (No. 1) was somewhat hyperplastic as there was a secondary anemia present. The relative low percentage of the White Cell Series and the increased percentage of Red and Marrow Cell Series is undoubtedly explained by this fact and is not to be attributed to the effects of *x*-ray exposure. In this experiment again, it will be noted that the left hind leg (control) was slightly more cellular throughout than the exposed side (right). The effects in this case could scarcely be attributed to *x*-rays as it will be seen that there were more cells in the left leg specimens before treatment.

As a check to this experiment, Dog 1 received a heavy dose over four ribs on the right side of the chest. The left side of the chest was used as the control. Exposure was as follows:

	Distance in.	Filter Aluminum mm.	kv.	Milliampere min.
Tangent to right chest (ribs) at apex of black spot. Left covered..........	16	9	100	630

At the end of one week, a piece of rib was resected from the right (exposed) side and from the left (control) side. These specimens were decalcified and sectioned. The sections were stained by the eosin-hematoxylin and Jenner-Giemsa method. The sections had to be cut too thick for satisfactory study. It is difficult to estimate changes in the marrow of flat bones, as it is so cellular that unless the changes are marked there is no base line for comparison. We looked for evidence of cell necrosis such as dense staining of the nuclei, pyknotic nuclei, vacuolated, poorly staining cytoplasm, etc. We also searched for evidences of mitosis and amitosis. As far as could be determined, at the end of one week, no changes had occurred in the rib exposed to a single large dose of *x*-rays. At the end of three weeks, the same procedure was repeated, a portion of a rib from the right and left sides of the chest was resected and examined as above detailed. We did not note any differences between the treated and the control side, nor any difference between these specimens and the specimens obtained two weeks before.

EXPERIMENT NO. 3

Effect on the Marrow of the Long Bones during and after Five Radiations over the Spleen: Small Doses

Dog 2244. Not used for experimental purposes for three months. Exposures to *x*-rays were given over splenic region, left half of upper abdomen, from front, as follows:

	Distance in.	Filter Aluminum mm.	Milliampere min.
3/3/23	12	9	50
3/10/23	12	9	50
3/17/23	12	9	50
After rest of one month:			
4/16/23	14	9	50
5/11/23	15	9	160

Chart No. 1. **Experiment No. 3**

X-ray Exposure Over Spleen.

	Right Hind Leg.				**Left Hind Leg.**			
Date of X-ray Exposure.	**Cells per field.**	**White Cell Series.**	**Red Cell Series.**	**Marrow Cell Series.**	**Cells per field.**	**White Cell Series.**	**Red Cell Series.**	**Marrow Cell Series.**
Before Exposure.	**6-7**	**52**	**28**	**20**	**7-9**	**49**	**27**	**24**
2 days after 1st exposure.	**6-8**	**51**	**24**	**25**	**7-10**	**46**	**25**	**29**
6 days after 2nd treatment.	**16-18**	**38**	**30**	**32**				
7 days after 3rd treatment.					**12-15**	**50**	**20**	**30**
Rest of 1 month. Then 5 days after 4th treat.	**12-16**	**48**	**20**	**32**				
20 days after 4th treatment.					**11-13**	**46**	**24**	**28**
8 days after 5th treatment.	**10-12**	**45**	**26**	**29**				
35 days after 5th treatment.					**3-5**	**52**	**26**	**22**

The results of this experiment would seem to indicate that it is possible to influence the marrow of the long bones by radiation over the spleen. The dose of *x*-rays best suited to this purpose, the frequency of application and the time interval required to obtain the optimum results still remain to be worked out. By consulting Chart No. 1, Experiment No. 3, it will be observed that during this experiment the number of cells per field were increased above the numbers found in any of the other experiments, also the number of cells of the marrow series were slightly increased. This finding indicates a true hyperplasia, as the presence of immature marrow cells in a rising proportion is of more importance than the mere increase in the number of cells in the smear.

EXPERIMENT NO. 4

Immediate Effect on the Marrow of the Long Bones of Repeated Small Doses of X-rays

Dog 1. No *x*-ray radiation for five months and nine days. Animal in good general condition. Treatments applied to inner aspect right hind leg directed to middle two-thirds of tibia.

	Distance in.	Filter Aluminum mm.	kv.	Milliampere min.
June 18/23	12	9	100	30
June 20/23	12	9	100	30
June 22/23	12	9	100	30
June 25/23	12	9	100	30
June 27/23	12	9	100	30
June 29/23	12	9	100	30
July 2/23	12	9	100	30
July 6/23	12	9	100	30
July 9/23	12	9	100	30
July 11/23	12	9	100	30
July 13/23	16	9	100	30
July 16/23	16	9	100	30
July 18/23	16	9	100	30
July 20/23	16	9	100	30

Chart No 1. Experiment No. 4.

		Irradiated Leg. Right Hind Leg.				Control. Left Hind Leg.			
		Cells per field.	White Cell Series.	Red Cell Series.	Marrow Cell Series.	Cells per field.	White Cell Series.	Red Cell Series.	Marrow Cell Series.
Frequent small doses to right hind leg. 3 treatments per week.	Before X-ray Exposure.	3-5	50	29	21	5-8	52	30	18
	1 week after.	3-5	50	31	19	5-8	48	28	24
	3 weeks after.	4-7	54	26	20	5-7	52	29	19
	7 weeks after.	4-6	52	28	20	3-6	52	29	19

A study of Chart No. 1, Experiment No. 4 shows practically no increase in number of cells or change in the relative percentages of the different types. The examinations of the marrow were made up to seven weeks after the first radiation and twelve days after the last. It is important to know what the remote effects of frequent small doses would show in the bone marrow, as this question has arisen in connection with the aplastic type of anemia which has occurred in roentgenologists.

CHANGES IN THE FORMED ELEMENTS OF THE PERIPHERAL BLOOD DURING *X*-RAY RADIATION EXPERIMENTS

Dog 2244. The only changes to be noted in the blood picture of this animal are a gradual increase in the percentage of hemoglobin. Between June 2, 1923 and June 16, 1923, an interval of two weeks, his blood count rose about one million cells. This was thirty-five days after the last radiation over the spleen. The most important finding in this series of blood counts is the increase in platelets which became apparent after instituting *x*-ray treatments over the spleen. This animal is an old dog and showed at the beginning a rather low platelet count which rose and maintained a higher level after the radiation over the spleen. The method used for platelet counting was Gram's modification of the Thomsen method.[7] This finding should be checked up by a larger series of carefully controlled experiments. The reticulated red cells were very little influenced by the *x*-ray radiation.

Dog 1 shows a gradual increase of both hemoglobin and red cells during the experiments. This is probably accounted for by the fact that this animal was anemic at the beginning of the experiments, and during the experiments was on a diet conducive to and under conditions favorable for blood regeneration. This regeneration was probably carried on chiefly in the marrow of the flat bones and was only slightly reflected in the marrow of the long bones. The weight and general condition of the animal improved markedly during the period of the experiments. The total gain in weight was 5 lbs.—from 35 to 40 lbs. There is no clear evidence that the *x*-ray radiation of the long bones brought about the increase in red cells and hemoglobin through irritation or stimulation of the bone marrow, not detectable in the examination of the bone marrow smears. Had this been the case, we feel that the number of reticulated red cells would have been higher throughout. It will be noted that the platelets remained at about the same level throughout. The white cells and the relative percentage of different types of white cells showed no changes in either animal that we regarded as having any particular significance.

Chart No. 5

BLOOD COUNTS — DOG 2244.

	Date.	Hgb.	R.B.C.	W.B.C.	Differential.						Platelets	Ret. Rs.
	Before X-ray.	%			PMN. %	PMB %	PME %	L. %	LM & T. %	%		%
	12/1/22	99	7,605,000	8,100	66		10	21	3		180,000	
					Occ. cell shows diffuse stippling.							
Irradiation over right front and right hind leg.	12/11/22	98	6,980,000	8,400	76		2	18	4		131,872	
	12/17/22	100	7,070,000	9,700							133,264	
	12/20/22	98	7,040,000	12,600	76		6	13	5		124,680	
					Many cells show diffuse stipp.					Turck.		
	12/23/22	95	6,450,000	13,000	66		2	23	7	I.F. 2	156,879	
					1 normoblast - many show dif. stipp.							
	1/1 /23	98	6,810,000	7,300	63		3	25	9	Myel.2		2.5
					Few cells show diffuse stippling.							
	3/3 /23	105	7,150,000	10,200	63		10	21	6		328,000	2.
	3/9 /23	110	6,860,000	10,000	77		5	17	6		310,000	1.6
	3/15/23	110	7,140,000	8,200	67		4	21	8		180,960	Less than 1
	3/18/23	110	7,000,000	9,000	74		7	13	6		356,000	1.
	3/22/23	110	7,120,000	8,200	79		2	13	6		320,000	1.
	3/31/23	115	7,140,000	8,400	69		4	19	8		392,000	1.3
Irradiation over spleen	4/5/23	110	6,950,000	10,200	73.5		4.5	13	8	Myel. .5	260,000	1.3
	4/14/23	110	7,320,000	7,600	54		1	40	5		240,000	1.2
	4/19/23	115	7,010,000	7,600	75		5	15	5			
	5/7/23	120	7,400,000	9,700	73.5		1.5	20	5		258,000	1.8
	5/10/23	120	7,230,000	9,000	66		4	24.5	4.5		352,000	1.7
	6/2 /23		7,360,000	8,400	73		8	16	3			1.5
	6/16/23		8,340,000	9,400	69		4	22	5		312,000	2.2

Ret. Rs - Reticulated Reds. Myel. - Myelocytes. Turck I.F. - Turck Irritation form.
Dif. stipp. - Diffuse stippling.

SUMMARY AND DISCUSSION

Four series of experiments were performed bearing on the effect of *x*-rays on bone marrow. The data secured from Experiments 1, 2 and 4 indicate that varying doses of *x*-rays have little or no effect on the bone marrow of long bones when applied directly over these long bones. This would be evidence against the practice of treating the leucemias by *x*-radiation over the long bones. One must take into consideration, however, that these experiments deal with marrow practically in a normal state of balance, while in the leucemias the marrow is in an abnormal state and filled with large numbers of immature cells. The same reasoning applies to the treatment of polycythemia over the long bones. The question of the reaction of pathological bone marrow to *x*-radiation may be entirely different from that of normal marrow. The results of Experiment 3 are suggestive and raise the question of the possibility of influencing the bone marrow much more readily through *x*-ray applied over the spleen than through direct application over the bones themselves. It is possible that radiation over the spleen by exposing the blood cells directly to the action of the *x*-rays results in increased blood destruction, and the products of destroyed and disintegrated blood cells may directly stimulate the bone marrow. The question arises here as to whether or not it is possible to depress the bone marrow through large doses of *x*-rays applied over the spleen. For example, do the lowered blood counts in the leucemias following *x*-radiation of the spleen occur as the result of bone-marrow depression and consequent decreased cell production, or do they occur as the result of leucemic cell destruction followed by a stimulation of the normal elements of the marrow? Such stimulation might result in increased proliferation of red cells and the normal types of marrow cells, restoring for the time the normal bone-marrow balance and inhibiting the production of the immature leucemic cell. Until we know more about why the spleen may at one time destroy large numbers of red cells, as in the hemolytic icterus anemias, and at other times proliferate large numbers of white cells, as in myelogenous leucemia, it will be difficult to work out methods of influencing bone marrow in a constructive way through the spleen. There is an increase in the cells of the marrow on the control side in Experiments 1 and 2 which might suggest that *x*-radiation of one portion of the marrow is able to cause a proliferation in some other portion of the marrow. It will be noted in the charts accompanying these experiments,

Chart No. 6

BLOOD COUNTS -- DOG 1.

	Date.	Hgb.	R.B.C.	W.B.C.	Differential PMN %	PMB %	PME %	L. %	LM & T. %	%	Platelets	Ret. Rs. %
	Before X-ray.											
	12/30/22	105%	5,690,000	8,700	64	1	13	16	6			
Expo- sure over right hind leg. Heavy dose.	1/3/23	90	5,650,000	15,100	80		2	12	5	Myel. 1	264,928	
	1/9/23	90	5,170,000	8,100	75		2	18	5		223,040	
	1/14/23	98	6,430,000	9,000	63		2	25	10		248,000	
	1/21/23	102	6,300,000	9,600	71		4	17	7	Turck. I.F. 1	240,000	
					1 normoblast seen. Cells show dif. stipp.							
	1/27/23	105	6,410,000	8,000	73		6	15	6		325,000	4.1
						Many cells show dif. stipp.				Turck.		
	2/ 3/23	106	6,520,000	10,900	74		5	12	8	I.F. 1	384,000	3.6
	2/10/23	112	6,500,000	9,400	70		8	13	9		303,328	3.2
	2/16/23	110	6,400,000	7,200	75		6	16	3		215,232	2.
	2/23/23	130	7,360,000	8,400	80		5	11	4		248,000	2.3
	3/ 9/23	115	7,180,000	8,600	76.5	.5	9	10	4		244,000	2.
	4/11/23	125	7,210,000	10,500	75		3	16	6		268,000	1.1
	5/30/23	120	9,450,000	8,200	63		13	20	4		344,000	2.4
Fre- quent small doses X-ray	6/23/23	125	8,020,000	8,600	59		8	17	6		312,000	1.9
	7/8/23	120	9,220,000	6,900	56		6	25	3		190,000	1.3
	7/14/23	118	8,740,000	8,600	63.5		6	27.5	3		264,000	1.8
	7/22/23	122	9,330,000	9,400	58		5	23	4		225,000	2.2
	over right hind leg.											

that the cells per field in the left hind leg (control side) are uniformly a little higher than in the treated side. This loses its significance, however, when we note that the smears taken before any *x*-ray applications were made showed more cells on the left than the right side.

CONCLUSIONS

1. Direct *x*-radiation of the long bones of the dog, in both light and heavy dosage, did not appreciably stimulate or decrease the contained marrow cells.
2. Repeated small doses of *x*-rays over the spleen caused a slight increase in the number of cells in the marrow of the long bones (right and left tibia) of the dog; also there was noted an increase in the proportion of immature marrow cells.
3. *X*-radiation over the spleen produced a rise in the number of platelets in the peripheral circulation, which rise was maintained during the experiment.
4. The general condition of both animals was improved during the experimentation and the hemoglobin and red cells increased. No untoward effects were noted as a result of frequent bone-marrow punctures.

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A ROENTGEN-RAY STUDY OF THE LA BREA (CALIF.) FOSSILS

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NOWHERE in the literature have I found a roentgen-ray study of any prehistoric pathological bones and I therefore thought a careful examination of the large collection of La Brea fossils might yield some interesting facts. These bones are really not fossils in the sense that part of the bone is dissolved out and replaced by silicates which are opaque to the roentgen ray, but are the result of an unusual means of preservation by crude oil and asphaltum. Few specimens other than those preserved in asphaltum have been roentgenographed. Out of a considerable number of elephant teeth and femurs removed from local sand-pits only one gave a satisfactory roentgenogram. A portion of this tooth had been dissolved out and not yet replaced with silicates.

The La Brea Collection at the Los Angeles County Museum is probably one of the largest collections in existence of prehistoric bones (there are over 1,000 complete skeletons of saber-tooth tigers and nearly as many of prehistoric wolves) but even in this number there is a surprisingly small percentage of pathological specimens and most of these are healed fractures. About one hundred pathological bones have been examined in this preliminary survey. Most of the bones are of animals larger than the fox; the bones of the smaller animals were probably crushed and eaten by the jaws of such powerful carnivora as the wolves and lions.

After being boiled in kerosene for one hour to free the specimens of crude oil they resemble bones that might be found in some forgotten corner of any anatomical laboratory, varying in color from black to light brown and are very light in weight. Many of the bones are fragile and all of

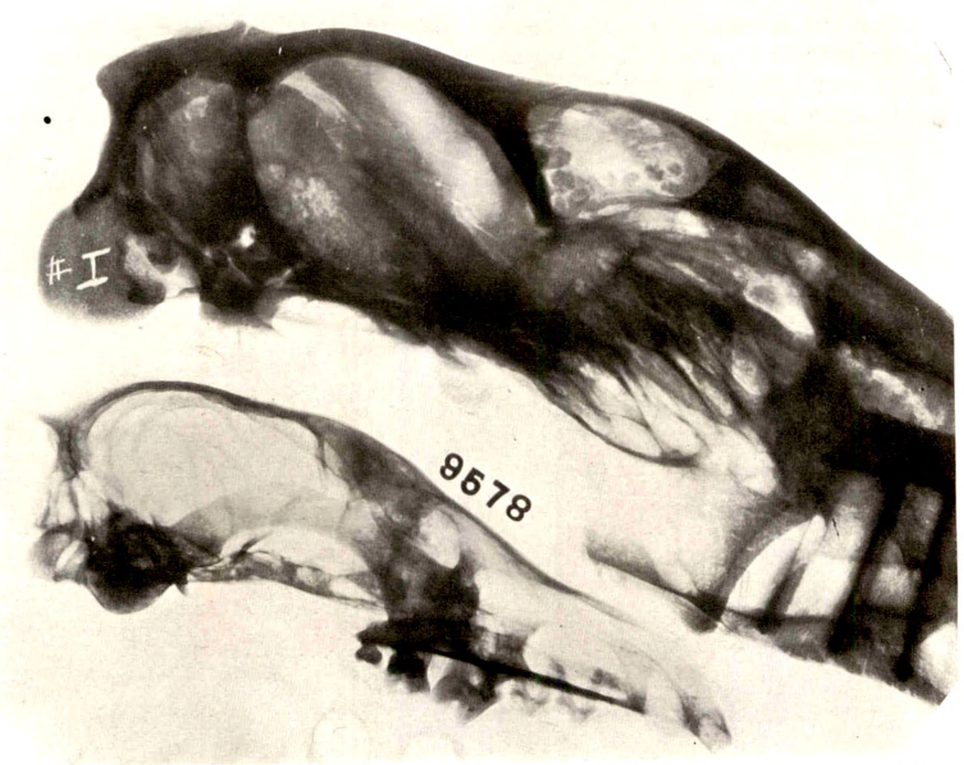

FIG. 1. Lateral half of skull of extinct ground sloth (Nothrotherium shastensis) which existed in large numbers during the Pleistocene period. The size of the brain was no larger than that of the extinct coyote shown below it, an animal at least ten times smaller in size. It relied chiefly on its giant claws which were both weapons of defense and powerful digging tools. The hide was studded with many scutes, very hard bony concretions as much as one-half inch in thickness, which were arranged in several layers, much like the steel disks in a Lee auto tire, thereby making it puncture proof as far as the saber-tooth tiger and other carnivora were concerned. The pathology in this skull is in the frontal sinus where several calcified nodules are present.

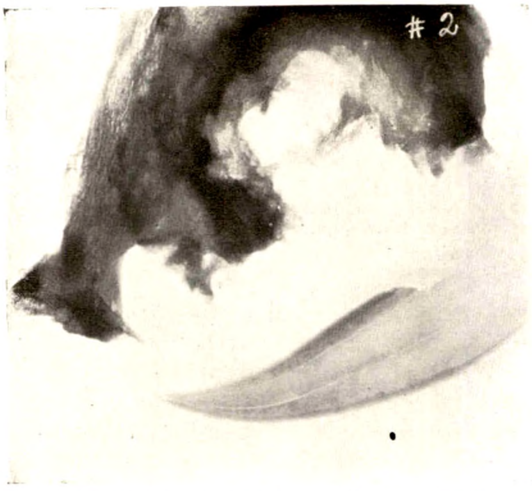

FIG. 2. Acetabulum of the saber-tooth tiger showing the destructive (tuberculosis) type of bone lesion. Beneath this is the temporary (saber) tooth of the tiger.

them very valuable, therefore the early work was done at the museum with a small portable outfit. However, in the study of the teeth of prehistoric elephants which are 6 in. in the narrowest diameter and of the same density as human teeth, long exposures on a 10 in. spark-gap with double screens are necessary. For all teeth and large bones the Bucky diaphragm is absolutely essential. Another difficulty is the removal of fine sand particularly in skulls, these are usually sawed in two so that they can be properly cleaned.

The lesions resulting from infection have been the first for observation. Unfortunately there is very little written from the roentgen-ray standpoint on the lesions of present day animals but the museum has diseased bones of modern animals and these were used for comparison.

Mr. J. W. Lytle of the osteological department of the museum broadly classifies these prehistoric lesions in two types, the productive and the destructive.

The destructive type somewhat resembles the lesions produced by tuberculosis of to-day. Tuberculosis is the only disease affecting practically all modern animals, including fish. History tells us that tuberculosis of animals was recognized as far back as the time when the Jews were captives in Egypt at which time they had several ecclesiastical laws forbidding the use of flesh from animals afflicted with tuberculosis.

The productive type resembles no particular present day type of infection. The bones, however, of a kangaroo obtained from the Seelig Zoo showed changes resembling the type observed in the saber-tooth tiger. Practically all bones of the kangaroo were affected, apparently a marked hypertrophic arthritis.

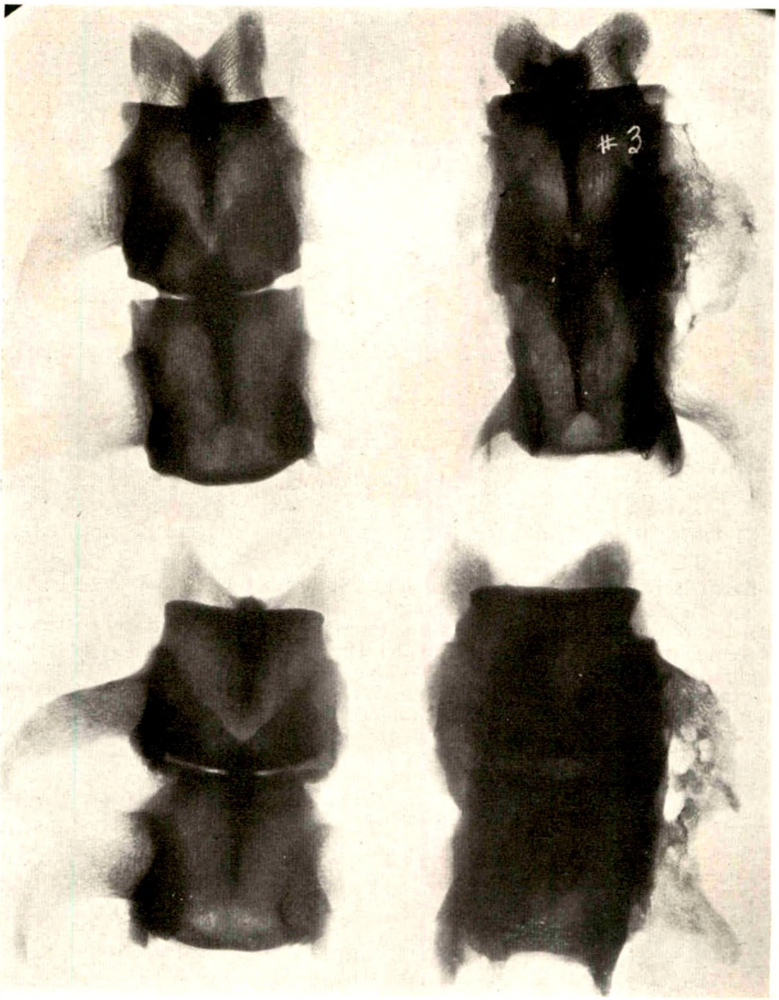

Fig. 3. Illustrates one method of study by comparison of pathological saber-tooth tiger vertebra with the normal of the same species and age. This is the productive type of bone lesion.

Whether the action of bacteria or the reaction of tissue to them was different in prehistoric times is of course difficult to answer, since the bacteria of that time may be extinct as well as their hosts. The non-motile, anaerobic, spore-bearing bacteria of to-day existing under rather wide ranges of temperature may be the result of evolution under adverse conditions and therefore the method of attack on tissues may be greatly altered.

At present the most that can be said is that the destructive type of prehistoric bone lesion somewhat resembles tuberculosis.

No study of the fractures has been made and no bone tumors were found. One interesting thing noted was that fossil fish imbedded in chalk, such as is found at Lompoc, California, can be roentgenographed in pieces nearly a foot thick with the aid of the Bucky diaphragm. Plates made at right angles to each other will save much tedious labor in preparing these specimens because the preparator will be able to localize objects sought, and quickly remove superfluous parts without damage to the specimen. Several other minor things of this nature were discovered and I am sure the roentgen ray can be used in this branch of Science to advantage.

The above is a preliminary survey and the subject will be more fully dealt with at a latter date.

DIVERTICULA OF THE STOMACH*

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IT may seem strange to you to speak on diverticula of the stomach, a condition which all writers have agreed to be a rare one. There is little in the English literature on the subject, more in the German literature; but all of it is rather poorly defined. Alexis Thompson[1] in 1910 went so far as to write that, "in the stomach diverticula are so rare as to be of little or no clinical importance." However, I was led to read up the subject after the finding of 2 cases of diverticulum of the stomach by roentgen ray. It is of importance for a roentgenologist to know something of the subject since he is the one who will make the diagnosis. The question of an operation will depend in many instances upon his interpretation of the roentgenographical findings.

A diverticulum is defined as "a pouch or pocket leading off from a main cavity or tube." These are divided into two types; the false and the true diverticulum. The false diverticulum is "an intestinal diverticulum due to the protrusion of the mucous membrane through a tear in the muscular coat" and the true diverticulum is "an intestinal diverticulum formed by the protrusion of the entire intestinal wall." In addition to this classification, diverticula are also spoken of according to their supposed etiology. In the case of esophageal diverticula, pathologists recognize two types; namely, those due to pressure, in which case it is thought that the force exerted by large boluses of food distend a weak spot in the wall and cause a bulging; and those cases due to traction in which inflamed structures become adherent and cause a tugging on the esophagus with a resultant pocket.

Strictly following the definition of a diverticulum, any outpocketing from the stomach as shown by giving barium to a patient should be spoken of as a diverticulum and we should have to include as such every case of a penetrating ulcer. However, no one considers the so-called Haudek's niche in this category. But we do have to consider the ruptured gastric ulcer which has become walled off, and we must attempt to differentiate it from pockets due to other causes. Boreszeky[2] has discussed his phase of the matter and reports 2 cases.

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* Read before THE NEW ENGLAND ROENTGEN RAY SOCIETY, May 4, 1923.

However, Heubel[3] has reported a case of gastric ulcer, which had caused a traction diverticulum and which later became adherent to the pancreas and formed a communication with the duct of Wirsung. Another case of a traction diverticulum is one that Tilger[4] discovered at postmortem. This was situated at the pylorus and was the result of adhesions to an old thickened gall-bladder. During life the patient had had no symptoms referable to the condition. Zahn[5] has also reported a case in which he could not decide whether the pouch was due to traction or to pressure.

As a matter of fact, the only case of a gastric diverticulum definitely due to pressure was one reported by Schulten[6] in which the patient had a large hair ball which had caused a local dilation.

Besides those just enumerated there have been several cases recorded in which no cause was given.[7,8,9,10,11]

But the cases which are the rarest and which interest us most are those of congenital origin. At one time it was thought that the true diverticula were congenital in origin. Thompson,[1] however, says that "the demonstration of acquired pouches in which all the coats are represented has made this distinction invalid and we now speak of congenital diverticula in which the protrusion depends on the persistence of fetal structures such as the vitelline duct." Zahn[5], writing in 1899, said that no congenital gastric diverticula had been observed up to that time. In 1908 Thompson[1] said that "a few specimens are recorded in which the stomach has presented one or more congenital pouchings which have been compared to the compartments of the stomach met with in ruminants." The only other instances recorded are those of minute diverticula in the vicinity of the pylorus associated with the presence of an accessory pancreas.

In 1910 Keith[12] reported having found one in the College Museum in London, and one in the London Medical Schools. Both of them were at the cardiac end, which is of interest to me in that this is the position of the two I have seen. One of these he reports, arose just below and behind the entrance of the esophagus. The one in Guy's Hospital Museum was composed merely of mucous membrane and arose near the esophageal opening. Sternberg[13] says that a few cases have been described of congenital infolding of the stomach, whereby it has become formed into a greater diverticulum. Falconer,[14] in 1907, reported a case of what he considered to be a congenital diverticulum of the stomach and duodenum because the muscle coats were all intact and greatly thickened. In this case the normal mucous membrane was replaced, as he expressed it, by a glandular tissue of lobules composed of alveoli lined by polyhedral cells closely resembling those of the pancreas.

Glinski[15] who has written on the finding of accessory pancreas in the gastrointestinal tract believed that they might be the cause of diverticula, and Nauwerck[16] has reported a case in which a definite accessory pancreas was found. But whether these cases can be classed assuredly as of congenital origin seems to be a little in doubt.

The 2 cases which we have had in the hospital emphasize satisfactorily the conditions and problems which this type of case presents.

CASE I. (No. 703) D. F. first entered the hospital in January, 1914, complaining of "gas pains." Family history and past history were essentially negative. The present illness began thirteen years previously when the patient started to have pain in the right lower quadrant. A year later her appendix was removed with some relief for one year. Her abdominal distress then became gradually worse as the patient became gradually more constipated. Six years before entrance to this hospital a roentgenographical examination was said to show obstruction in the right iliac region and some adhesions were freed. One and a half years before entry the patient had an attack of pleurisy in the left chest and two weeks later she had a very sudden attack of pain in the epigastrium with tremendous distention, pain and cyanosis. The distention caused marked dyspnea and some delirium. This condition lasted for four hours and passed off gradually without treatment. Constipation and abdominal distress increased steadily up till time of entrance. Physical examination was essentially negative. The patient improved under a constipation regime, so that she was discharged after a twenty-one day stay in the hospital with a diagnosis of constipation. The patient entered the hospital again eight years later in April, 1922. Since her previous admission she continued to be troubled with constipation and abdominal distress, and five years before her second admission to this hospital more roentgenograms of the gastrointestinal tract were taken, she was operated upon, and more adhesions were freed. Physical examination was again negative except for slight dulness over the apices of the lungs. Chest plates, however, reveale extensive tuberculosis. Roentgen studies of the gastrointestinal tract (#966) were as follows: "This stomach occupies a medium position with a normal peristalsis and tone. Just at the cardiac orifice there is a definite diverticulum about 2½ cm. in diameter on the lesser curvature side of the stomach. There was some barium remaining in this diverticulum at the end of six hours. The rest of the examination was negative." (Fig. 1).

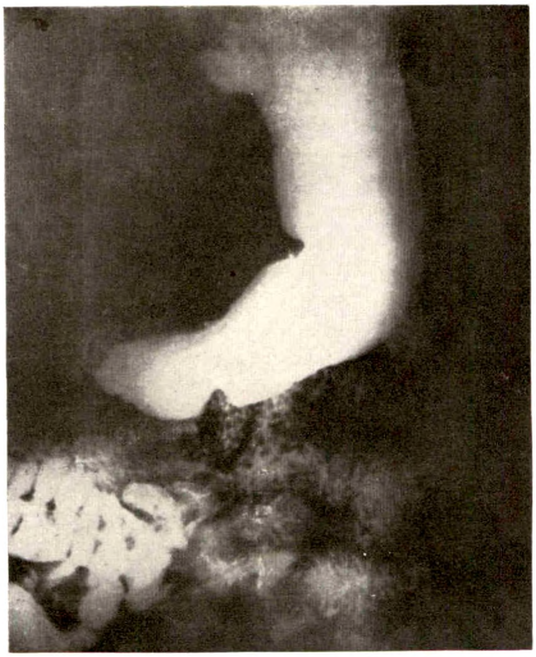

FIG. 1. The connection of the diverticuulm does not show on the plate but was definitely made out fluoroscopically.

The patient was then discharged to a sanatarium for treatment of her lung condition. A year later the patient returned to this hospital for a neurological condition and roentgenograms of her stomach showed exactly the same findings.

The question arises about this patient as to how long she has had this condition. Is this a congenital diverticulum like the cases reported by Keith? If so, it has been missed in several roentgen examinations. If it is not congenital when and why did she develop it? Could it have occurred at the time she had her severe epigastric pain associated with her pleurisy? But she has had a negative barium series since that time. We are not helped by her symptoms as they can all be explained on the basis of her other pathological findings. Finally, what are we going to do for it? Knowing so little about the condition it would seem best to do nothing until we have more definite information on the subject.

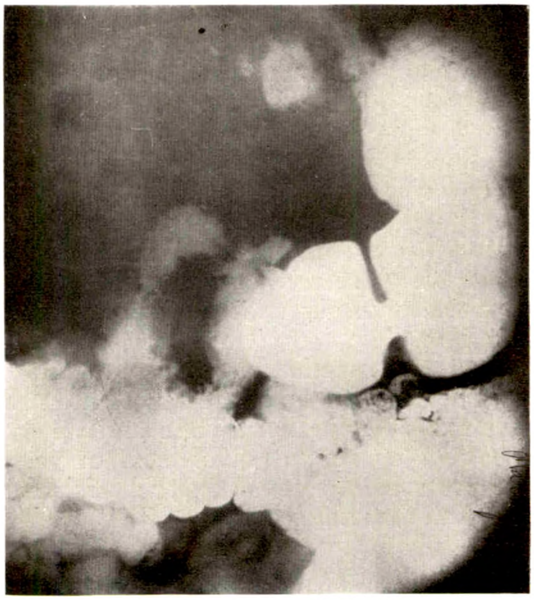

FIG. 2. The diverticulum is shown just below the esophageal opening. Its connection with the stomach shows fairly well.

CASE II. (No. 19269). J. H. aged forty-eight, entered the hospital in August, 1922, complaining of "pain in the stomach." Family history, habits and past history are unessential. The present illness began fifteen years ago with belching of gas after meals. Ten years ago the patient began to have a dull aching epigastric pain usually coming on at night with intermissions of several months. For ten weeks it has been radiating over the precordium. It is not definitely related to meals. However, after eating he often feels a sensation of burning fire beneath the sternum. Roentgen studies (#25891) of the gastrointestinal tract showed, "a constant projection from the lesser curvature of the stomach just below the cardiac orifice forming a circular protuberance about the size of a quarter with a narrow neck. The gastric outline was otherwise negative but the stomach showed vigorous peristalsis. The duodenal cap was small and rather constantly deformed in its first portion. Impression: Findings are strongly suggestive of duodenal ulcer. The projection noted above is thought to be a diverticulum from the stomach" (Fig. 2).

Here we have a patient whose symptoms can again be explained by pathology other than the diverticulum, and in view of our present knowledge we decided to do nothing about it.

For the present, then, the diagnosis of gastric diverticula has to be made by the roentgen examination for there are no characteristic symptoms so far as we know. In those patients with traction diverticula their symptoms, if any, are those found in any inflammatory condition with adhesions, and in all cases reported there has been enough other pathology to warrant all the symptoms complained of without having to consider the diverticulum per se. In the case of the patient with the hair ball the chief symptom was that of epigastric pain, and as there was a definitely palpable tumor in the right side the patient was operated on. Of the congenital cases, Falconer's had no symptoms, and the other cases had more pathology which could account for their history.

Therefore, without pathognomonic symptoms or signs one requires the roentgenographic picture of a sack communicating with the stomach in order to make a diagnosis. But even if one finds such a condition it is difficult, and at times impossible, to decide the etiology of the condition portrayed. Ulcer must be recognized by the secondary signs found in the roentgen ray; if these are wanting we must fall back on the patient's history. Thus if a patient has no secondary signs but has had at any time a history suggestive of ulcer, it is safest to make a diagnosis of an old penetrating ulcer merely by the law of chance; or if the patient has or has had a history which could be interpreted as inflammation with adhesions, it is best to focus one's attention on neighboring organs, such as the gall bladder; for it is doubtful if the gastric pouch is the primary condition. Of the cases in the literature there is no evidence to show that a congenital diverticulum of the stomach ever causes adhesions. The diagnosis of congenital diverticulum, therefore, rests on the presence of a gastric diverticulum as shown by roentgen ray with no evidence either by symptoms or signs to explain its presence.

Now granting a diagnosis of diverticulum has been made, what is one to do about it? From what has been said it would seem best to leave it alone. On the other hand Mayo[8] and Carman and Miller[17] have reported cases showing carcinoma, and Mellon[10] et al. reported a pedunculated diverticulum nearly opposite the cardiac opening of the stomach, the histology of which the authors felt could be diagnosed as precancerous. The latter writers are strongly of the opinion that gastrointestinal diverticula favor malignancy. As yet we have not enough evidence to warrant any definite conclusion, and we can lay down no definite rules for treatment. Each case must be considered individually.

SUMMARY

In this brief paper I have attempted to correlate as well as possible the literature on a condition which is very rare and about which very little is generally known. With the general use of the roentgen ray, we are occasionally going to see cases such as I have reported tonight, and we ought to have some idea as to what we may be dealing with. At the present time nothing is known concerning the symptoms which congenital diverticula may produce and we have to rely on the roentgen ray to make the diagnosis. But if others will report such cases as they find them, we may be able to obtain some definite ideas concerning gastric diverticula.

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A CASE OF PNEUMOCONIOSIS WITH AUTOPSY FINDINGS

BY J. H. GREEN, M.D.

ROCHESTER, NEW YORK

During recent years occupational diseases have gradually assumed an importance which must be seriously taken into account in the differential diagnosis of diseases of the chest. In many instances findings in the chest that are otherwise unaccounted for are made clear by close attention to the occupational history of the patient. With this fact in mind I am taking this occasion to present a case of pneumoconiosis that we had under observation for some time.

J. P., an English stone cutter, aged thirty-eight, entered the sanatorium in August, 1919. He gave a history of cough for the past several months, with fever, and lassitude. He had expectorated blood one month previous to his admission.

Physical Examination. Right Lung: Breath sounds normal but there were a few rales at the apex and at the base, front and back. Left Lung: Few rales at the base, front and back.

The roentgenogram showed a dense mottling throughout both lungs (Fig. 1).

The sputum was negative on fifteen examinations.

We diagnosed this case miliary tuberculosis. This diagnosis was made largely on the misinterpretation of the roentgenogram and partly on failure to go into the patient's history more thoroughly. The patient improved very much on sanatorium treatment and the diagnosis was changed to pneumoconiosis. He was then discharged, improved, in November, 1919, but was advised not to work as a stone cutter. This advice was disregarded after he had been at home several months. In consequence he again became ill and was readmitted to the sanatorium in April, 1922, with the following history: He had rested at home for twelve months and his health had been quite good. After this he had worked for eight months when his health gradually failed. The

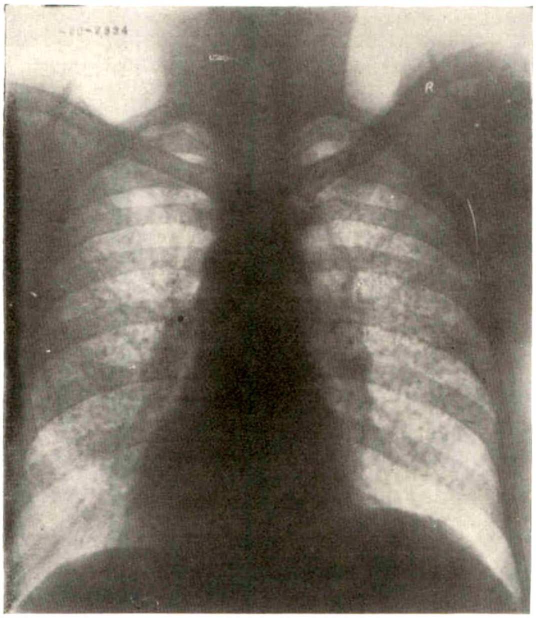

Fig. 1. Roentgenogram on admission showing dense mottling throughout both lungs. Appearance simulating that of miliary tuberculosis.

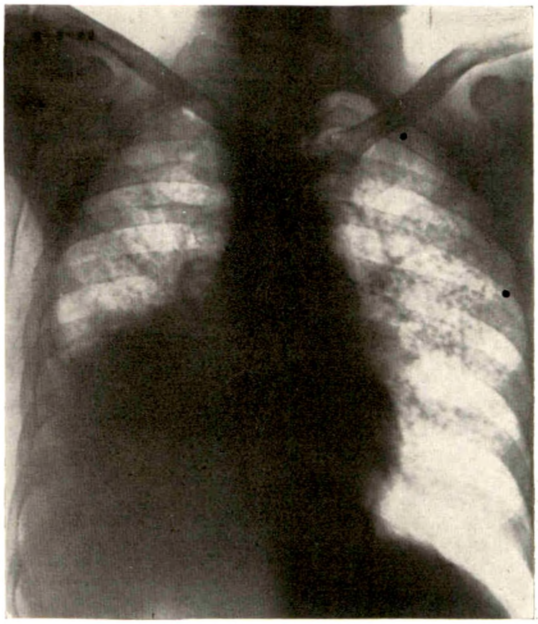

Fig. 2. Mottling throughout right lung and upper part of left lung with dense shadow lower half of left lung. This shadow on autopsy proved to be pyopneumothorax.

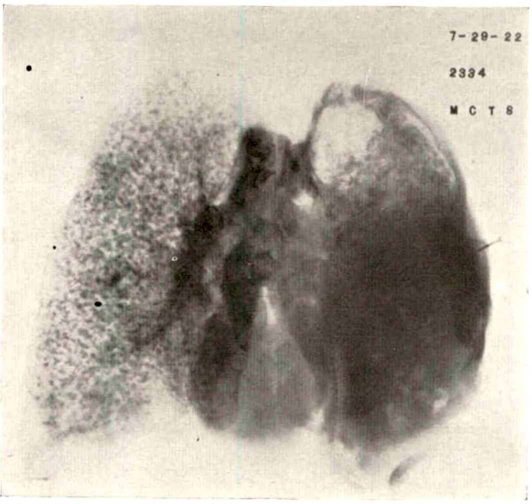

Fig. 3. Heart and lungs removed in toto, showing mottling of right lung and upper part of left lung. Lower left shows many cavities.

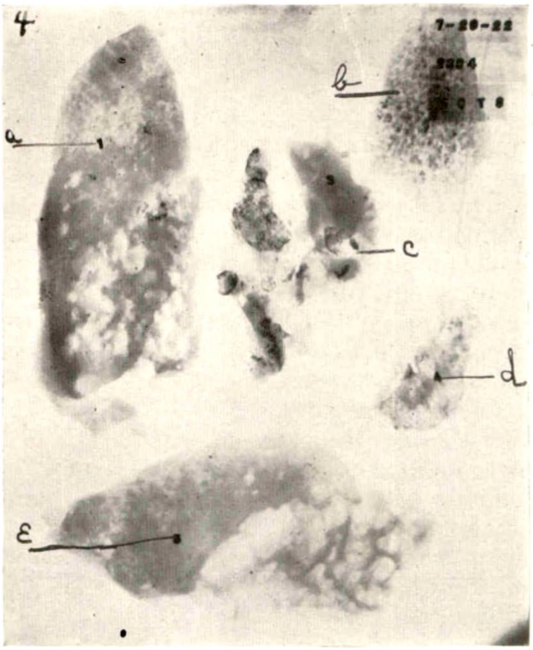

Fig. 4. Roentgenograms from sections of lungs. See page 360.

chief complaint was dyspnea. On readmission he had pain in his left side, a severe cough, expectoration, blood-streaked sputum and temperature 103° plus, almost every day.

Physical Examination. Right Front: An area of bronchial breathing at the level of the 3rd rib. Right Back: A small area of dullness near vertebrae at the level of the 5th and 6th vertebral spines, with a few rales.

Left Front: Dullness from the 4th rib to the base. Distant breathing at the level of the 4th and 5th ribs with absence of breath sounds 5th rib to base. Left Back: Dullness from the 4th rib to the base. Distant breathing from 5th to 8th dorsal spines with absence of breath sounds from the 8th dorsal spine to base.

The roentgenogram on the second admission showed dense mottling throughout the right lung; dense mottling upper half of the left lung, and a very dense shadow lower half of the left lung (Fig. 2).

The patient's temperature stayed around 103° each day. This was accompanied by a severe cough and very profuse expectoration, frequently tinged with blood. His general condition gradually grew worse and death occurred in July, 1922.

Roentgenograms were taken after death which showed practically the same as was shown in Figure 2. On opening the pleural cavity a pocket containing 500 or 600 c.c. of bloody pus was found at the left base. There was an opening from the lung into the pleural space (pneumothorax). The lungs and heart were removed and roentgenograms were taken which showed the same mottled appearance throughout the right lung and the upper part of the left lung as described above. The lower part of the left lung showed many cavities. Chains of glands could be seen extending down to each hilum—probably due to deposits of stone dust (Fig. 3). On section these glands gave a gritty sound against the knife. The lungs were sectioned and roentgenograms were taken as follows (Fig. 4):

(*a*) Longitudinal section of left lung with the lower part honey-combed with cavities.

(*b*) Section from the right apex showing the dense mottling described above.

(*c*) Section from the root of the right lung showing hard glands probably due to deposits of stone dust.

(*d*) Section from the root of the right lung showing a small piece of gland and mottling outside of root of the lung.

(*e*) Same as (*a*).

Dr. Dunham says: "A correctly interpreted roentgenogram is the most valuable aid in the differential diagnosis of diseases of the lung." One cannot lay too much stress on the phrase, "correctly interpreted." To follow this advice a history, including an occupational history, physical findings, roentgenological findings, and laboratory findings must each be accorded its proper valuation, giving one a solid foundation on which to base a diagnosis.

THE ROENTGEN DIAGNOSIS OF ANEURYSM OF THE AORTA*

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NEW ORLEANS, LOUISIANA

THE differential diagnosis of aneurysm of the aorta, dilated aorta and aortitis is quite difficult without the aid of the roentgen ray. The routine study of all chest and abdominal cases with the aid of the roentgenoscope will quite often reveal lesions of the vascular system that were not suspected at the time of the physical examination, no matter how carefully made. I emphasize the roentgenoscope because more information is to be gained from the actual visualization of the part under study and films are only made to confirm the shadow seen. The taking of a film in only the antero-posterior position is quite misleading and we should discourage this type of half-hearted examination which is seen only too often.

Unfortunately we have no absolute standard of measurements that are applicable in all types of individuals. The work of Vaquez and Bordet in France has gone a long step forward in establishing a working basis for these examinations. Observers differ, however, in the interpretation of shadows, so that what appears to be a dilatation to one is an aneurysm to another.

To illustrate this, a patient was seen several years ago for some gastrointestinal symptoms and during the routine roentgenoscopic examination of the chest in all planes, I saw what I thought was a bulge in the transverse aorta. I tried to get a two-meter film and, though I was unable to see this shadow in either the right or left lateral positions, I reported my findings to the clinician. After careful physical examination, he was unable to find any pathology in this region. The patient, a very intelligent man, was told of this suspicion and about six months later visited an eastern clinic where he was examined by one of my colleagues who said there was a slight enlargement but not enough to worry about. I had occasion to see this man about two years later for the same clinician, and at that time, I found a well marked cylindrical aneurysm of the transverse aorta. This finding was later confirmed by my colleague in the east.

In this age of preventive medicine, the early recognition of an aneurysm is quite important for the prognosis because if it is seen early, the outlook for life is much longer and more comfortable, especially when there is a definite history of syphilis. I might say here that we have found that about 95 per cent of all aneurysms will give a positive Wassermann and, even if the reaction is not positive, the usual anti-luetic treatment is instituted.

The differential diagnosis of sacciform aneurysm and cylindrical dilatation is quite easily made, as in the sacciform type we see a definite sac which is usually pulsating; you must remember, however, that we can have a large, sacciform aneurysm without pulsation in the sac, accounted for by the clotting and organization that often takes place. I would call attention to the danger of mistaking a transmitted pulsation from the aorta to a large group of glands for an aneurysm. We have seen this reported quite often but a careful roentgenoscopic examination will eliminate this error.

In the patients with a cylindrical dilatation, we are able to see the thoracic aorta through its entire course to the diaphragm. This brings us to the consideration of the diagnosis of abdominal aneurysm. We have never been able to recognize an aneurysm below the diaphragm, by the aid of the roentgen ray no matter what the type. One patient was operated upon for abdominal tumor and a large sacciform aneurysm of the abdominal aorta was found. He was closed, and two weeks later we tried by every known means at our disposal to get some evidence of a tumor or a pulsation. We met with absolute failure. Pneumoperitoneum was not tried because we knew nothing about it at the time, but I would not use it even now with our perfected technique because, of all things, we do not wish to cause any additional intra-abdominal pressure.

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* Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, Jan. 21–24, 1924.

We have seen cases with eroded vertebrae due to pressure of the tumor, with terrific abdominal pains. A diagnosis of abdominal aneurysm cannot be made on this finding alone as a new growth of the vertebrae will cause the same signs and symptoms, and it is often only at the autopsy table that the correct diagnosis is made. After careful study of all films made in many hundreds of cases we have never seen the plaques in the abdominal aorta of which we have been told. Our technique may be at fault, but we are trying in every case of thoracic examination to make an examination of the abdomen as well, and it is our opinion that calcified plaques cannot be depended upon for a diagnosis of aneurysm of the abdominal aorta.

I do not think we can very well consider aortitis in this group as I think the beginning of all cases of aneurysm of the aorta is in an infiltration and roentgenologists do not see the patients in this early stage. This is due to the fact that the patient, as a rule, does not consult the clinician until the condition has advanced beyond this early stage.

In closing, I again want to make the plea that in all cases referred to you for any chest or gastrointestinal lesion, you carefully examine the aorta in all positions with the roentgenoscope and the two-meter films at three angles. The films are made for comparison with future examinations of the patient, in order to determine the progress and to guide the prognosis.

ABSTRACT OF DISCUSSION

Dr. Baetjer (Baltimore) emphasized the difficulty encountered in differentiating aneurysm from solid tumors and stated that he relies entirely upon the roentgenoscope for the diagnosis, and uses plates only to make a permanent record of the case. He spoke also of the rarity of the recognition of aneurysm in the days before the use of the roentgen ray. Then, it was unusual to have more than one case a year, while now he can cite a period of two years when there were 118 cases of aneurysm in the out-patient department and wards.

Now that the internist has become more accurate in his methods the number found only by roentgen examination is not so great as formerly. Dr. Baetjer stated that his experience bears out Dr. Samuel's statement that roentgen examination is of little value in diagnosis of abdominal aneurysm. He believes also that fully 85 per cent of cases of aortic aneurysm have a small heart.

Dr. Hunter (Norfolk) reported a case of aneurysm to illustrate the point that pulsation is not always present in aneurysm. Organization of the clot may convert an aneurysm into a solid, non-pulsating mass.

Dr. Stewart (New York) referred to several cases of abdominal aneurysm with positive roentgen findings; all of them, however, were at the level of the diaphragm and the globular shadow could be seen extending upward into the chest.

Dr. Manges (Philadelphia) discussed the question of multiple sacs in aortic aneurysm. A majority of the pouches on the transverse portion project forward, but some project backward and that is one reason for difficulty in recognizing them clinically. He has seen a number of aneurysms in which pulsation could be felt on the posterior and not on the anterior chest wall, and in which the physical signs were definite posteriorly but not anteriorly. He reported a case in which there was present substernal thyroid and also an aneurysm of the innominate artery.

Dr. Samuel (closing). I tried to make my paper as short as I could, but it seems that I must elaborate somewhat. I agree with Dr. Baetjer that we have found very little displacement of the trachea; the tracheal tug is missing in a large percentage of these patients, and the bruit is seldom found. Aneurysmal bruit is one of the old signs that has always been relied upon, and when it is present it means something, but it usually is not present. Now the question of the organization of the clot. In the organization of the clot you get no intrinsic pulsation and are able definitely to differentiate the two shadows. I want to be thoroughly understood here, that the clinical examination by a competent clinician must go hand in hand with the roentgenologist. That is something we cannot get away from. It is very important that clinical examinations be taken into consideration in diagnosis of aneurysm, unless it is large, pulsating, and unmistakable; for the early recognition of aneurysm the roentgenologist must work hand in hand with the clinician.

The multiple sacs that Dr. Manges spoke about we have seen in some cases. The percentage is not large. The small heart usually accompanies aneurysm in the usual type of patient outside the hardworking laborer. In the majority of cases the heart is of the small type.

We have usually found the sac anterior, but in the descending aorta it is usually posterior. The question of substernal thyroid I do not want to touch on at the present time.

The diagnosis of mediastinal tumors is practically made with the roentgenoscope with the help of the clinician. In Hodgkin's disease and allied conditions, you must take the clinical examination into consideration. The pathologist must help on the blood count, the Wassermann, etc. The case is not simply the screening or plating of a patient, and when we are satisfied with such partial examinations, we are courting failure. If we are not content to work with the clinician, we are going wrong.

METASTASIS

Malignant disease is transferred to distant structures by conveyance of tumor cells which have become detached from the parent growth. Undoubtedly, the most important avenue of dissemination in the early stages of carcinoma is furnished by the larger lymphatic vessels which join the affected organ with its regional lymph nodes, and, however distant the cancer cells may be in the later stages of the disease, it is to the lymph nodes adjacent to the primary growth that we must look for the first clinical evidence of metastasis in the great majority of instances . . .

Unfortunately, the process of cancer dissemination is an exceedingly complicated one, and while embolic invasion of adjacent lymph nodes regularly occurs, the further progress of the metastatic cells presents many problems that are far from satisfactory solution . . .

Handley maintains that cancer of the breast spreads from the primary tumor centrifugally in all directions along the plane of the deep pectoral fascia, with extensions upward into the skin and downward into the subjacent tissues. The outermost limit of this circle of dissemination is represented by "a microscopic growing edge of carcinoma cells" . . .

It would be impracticable to repeat in detail the arguments advanced by Handley in support of his theory; suffice it to say that it commends itself as a rational explanation for regional dissemination in cancer of the breast and for a large percentage of local post-operative recurrences, and at the same time serves as a rational theory for planning the radical removal of a carcinomatous breast.

From THE BREAST: ANOMALIES, DISEASES, TREATMENT *by* DEAVER and McFARLAND, p. 494 et seq., Blakiston's, Philadelphia, 1917.

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Ninth Annual Meeting: Hotel Drake, Chicago, Ill., June 9–10, 1924.

R Walter Mills

[1878-1924]

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Information of interest to all readers will be found on page vii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

DR. R. WALTER MILLS

The untimely death of Dr. R. Walter Mills at forty-six years of age was announced in the Journal last month. Although Dr. Mills was not a member of The American Roentgen Ray Society he was well known to our entire membership because of his frequent contributions to the programs of our meetings. This year he had applied for membership in the Society and we were looking forward to the pleasures of a closer association. His passing at this time is not only a great personal loss to his many friends, but a real loss to roentgenology and internal medicine to which he was constantly making notable contributions.

Dr. Mills was born in Webster Groves, Mo., and began his education in its public schools. In 1899 he secured his B. S. degree from the University of Illinois and in 1902 graduated in Medicine from the St. Louis University School of Medicine. After his interneship he practiced general medicine in St. Louis during 1903 and 1904. In August, 1904, he was married to Miss Irene M. Goodberlet of St. Louis and then practiced medicine in Webster Groves, Mo., from 1905 to 1911. In that year he studied under Dr. Ludwig Kast in New York and also made a trip to the clinics of Europe after which he returned to practice gastroenterology in St. Louis.

In the year 1913 Dr. Mills made another trip to Europe and for several months studied at the clinics in Berlin, Vienna, and Halle under Drs. Martin Haudek, G. Holzknecht, Siegmund Krenzfuchs, and M. Sussmann.

Upon his return to this country in the fall of 1913 he became associated as a partner with Dr. H. W. Soper in the practice of gastroenterology. He remained in this association and in this work until his death.

Dr. Mills was an indefatigable and fruitful worker and a prolific writer. During the past ten years he has made many important contributions to the literature of gastroenterology and especially of roentgenology as applied to diseases of the gastrointestinal tract.

He was a member of the following organizations:

- American Gastroenterological Association, of which he was president at the time of his death.
- St. Louis Society of Internal Medicine, of which he was president during the year 1923.
- American Medical Association.
- St. Louis Medical Society.
- St. Louis Naturalist's Club.
- St. Louis Anthropological Society.
- American Ornithologist's Union.
- The Radiological Society of North America.
- Phi Delta Theta—Missouri Gamma Chapter.
- Phi Delta—Alpha Zeta Chapter

Dr. Mills did notable work in roentgenology but his main interest was in clinical medicine, as a perusal of the titles of his publications listed below will show:

The *x*-ray in the diagnosis of gastric ulcer and its sequelae. *Surg., Gynec. & Obst.*, July, 1913, pp. 1–25.

Points of value in roentgenology of the gastrointestinal tract. *J. Am. M. Ass.*, Oct. 11, 1912, lxi, 1344–1348.

Observations on duodenal ulcer with special reference to its *x*-ray diagnosis. *Interstate M. J.*, xxiii, No. 4.

The relation of bodily habitus to visceral form, position, tonus and motility. AM. J. ROENTGENOL., 1917, iv, No. 4, 155–169.

The *x*-ray test of gastric motility. *Tr. Am. Gastro-Enterol. Ass.*, 1918, pp. 36–47.

The relation of visceral form, topography and function to the general physique with a classification of types. Pottenger's Clinical Tuberculosis, i, 335–356.

Radium treatment of cancer of the esophagus under roentgen-ray control. *J. A. Mm. Ass.*, June, 1920, 74, 1570–1576.

Syphilis of the alimentary tract and extra-abdominal viscera. *Am. J. Syphilis*, iv, No. 3, 1920.

Syphilis of the gastrointestinal tract. Nelson Loose-Leaf Living Medicine, Vol. 5, Chap. xv, pp. 311–318.

The relation of roentgenology to clinical medicine with special reference to gastroenterology. AM. J. ROENTGENOL., Nov., 1920, xii, No. 11, 523–531.

X-ray evidence of abdominal small intestinal states embodying an hypothesis of the transmission of gastrointestinal tension. AM. J. ROENTGENOL., April, 1922, ix, No. 4, 199–223.

Intestinal obstruction. Tice's Practice of Medicine, vii, 639–666.

Complete gastric motility in different types of habitus. AM. J. ROENTGENOL., Nov., 1922, ix, No. 11, 731–734.

Gastric motility after pyloric obstruction in infancy. *Am. J. Dis. Child.*, Nov., 1922, xxiv, 404–412.

Dentistry as a branch of medicine. *Internat. J. Orthodontia*, Nov., 1922, viii, No. 11.

Further observations on the radium treatment of cancer of the esophagus with a review of forty-four cases so treated. AM. J. ROENTOGENOL. & RAD. THER., Feb., 1923, x, No. 2, 148–161.

Present medical trends. Papers of the Wednesday Club of St. Louis, Jan. 24, 1923.

Direct evidence of colonic secondary changes and reactions. *Tr. Am. Gastro-Enterol. Ass.*, 1923, pp. 250–254.

The routine of a barium enema. (This paper was to have been read before the American Congress on Internal Medicine, Feb. 22, 1924.)

The red fox and the question of its importation or nativity. (Not as yet published. Read before the St. Louis Naturalist's Club, Jan., 1922.)

Medicine Bow country and its birds. (Not as yet published. Read before the St. Louis Naturalist's Club, Jan., 1923.)

ROENTGENOLOGY OR RADIOLOGY?

From time to time there has been discussion among roentgenologists and radium therapists of the nomenclature to be employed in these special fields of medicine.

The question has again arisen in connection with the proposed section in the American Medical Association which was announced in last month's issue of the Journal. The final decision rests, of course, with the House of Delegates of the American Medical Association, but presumably consideration will be given to the opinions of those members who will naturally compose the section if it is finally formed.

We are frankly of the opinion that the most suitable name is the "Section of Roentgenology and Radium Therapy."

Radiology is a term more suitable to matters pertaining to radio or wireless telegraphy than to roentgenology, and it is equally unsatisfactory as a term to include radium therapy.

Both "roentgenology" and "radium therapy" are definitive while "radiology" is a loose and ambiguous term.

Another important reason for adopting "roentgenology" is the fact that it has been accepted as the official terminology, not only of the American Roentgen Ray Society, but of the American Medical Association itself. It would not seem consistent for the latter to give to one of its Sections a name not recognized in the nomenclature in use in its Journal.

We therefore respectfully recommend to the House of Delegates that, if final approval is given to the formation of a new section, its most appropriate designation would be the "Section of Roentgenology and Radium Therapy of the American Medical Association."

AMERICAN REGISTRY OF RADIOLOGICAL TECHNICIANS

This Board has been organized through the initiative of the Radiological Society of North American and has received the formal recognition of the American Roentgen Ray Society. The latter Society at its annual meeting in 1923 appointed one of its members, Dr. Edward S. Blaine, to serve on the Board.

The primary object of the Board as stated by its President "is to foster and to encourage the highest ideals in the vocation of Radiological Technicians. The chief value will be to the technicians themselves, but also, Radiology will be benefited by the service of technicians whose ideas are high and whose standards are well defined."

There have been misgivings on the part of some roentgenologists with regard to the official recognition of technicians, based almost entirely upon the idea that such recognition might be abused. The Board has attempted to minimize the opportunity for abuse of their licenses by any unprincipled technicians by making the following Agreement a part of the application for license: "If I receive a certificate from the American Registry of Radiological Technicians, I hereby agree to work at all times under direct medical supervision, and under no circumstances to give out written or oral diagnoses, or work independently, whether in any private office, hospital or institutional laboratory."

Attention is also given to an investigation of the character as well as the ability of the applicant for registration, and a further safeguard is the provision that the license must be renewed yearly.

The sponsors of this movement are not under the delusion that simply licensing technicians will abolish or even lessen the number of commercial laboratories, but they are convinced that proper recognition of the technicians will tend to foster in them higher ideals and that it will gradually create an organized body with a high standard of ethical conduct.

Roentgenologists are asked to cooperate in this movement by bringing the matter to the attention of the technicians employed by them.

All communications should be sent to Mr. J. R. Bruce, Executive Secretary, Guardian Life Building, St. Paul, Minn.

GENERALIZED OSTEITIS FIBROSA

We wish to call to the attention of our readers the October, 1923, issue of the Edinburgh Medical Journal. The entire number is devoted to the report of a case of generalized osteitis fibrosa, with parathyroid tumor and metastatic calcification, and includes a critical discussion of the histology of this disease and of the pathological processes underlying osseous dystrophies.

The report includes a concise history of the development of knowledge of those diseases called by the French "Osseous Dystrophies" and by the Germans "Rachitic Malacias."

The history of the authors' case is given in great detail and includes its clinical aspects, the roentgenological and laboratory findings, and the histology of various bones and of the parathyroid tumor.

In their Summary under Interpretation of 'Fundamental Histological Changes' the authors state that "Osteitis Fibrosa has been regarded by the writers as a distinct pathological entity. It is characterized by (a) bone resorption; (b) fibrous tissue substitution; and (c) new formation of bone—both reticular bone and apposition bone. Variations in the histological picture may be related to the fact that the process is observed at different stages, and to modifications in its development due to the fact that the course of the disease is not uniform and progressive, and to the further fact that remissions may occur. If remissions and healing do occur, a new architectural reconstruction of the bone takes place, under the influence of osteoblasts and osteoclasts, to meet the mechanical and circulatory influences to which the new bone is subjected."

Under the heading "Pathogenesis-Metaplastic Malacia" the following conception of the authors is given: "– – – –the initial change is in the activity of the bone cell and not in the stroma elements of the bone marrow. This degenerative change in the bone cell is followed secondarily by a reaction in the cell and blood-vessel content of the Haversian system, which, while inflammatory in character, appears to have a deeper significance, for it results in a reversion to an embryonic cellular tissue that is potentially metaplastic.

"The anatomical conception underlying the term 'malacia' is confirmed by the histological picture, for there is a progressive decalcification and resorption of the old bone and its replacement by an osteoid, i.e., non-calcified, tissue. The epithet 'metaplastic is justified, because the functioning cells of the Haversian system have assumed the character of an early mesenchyme cell and subsequently differentiate along several lines. This preliminary reversion and later differentiation are implied in the term 'metaplasia.' Metaplasia signifies the transformation of one tissue into another of similar morphological origin and functional character: it takes place in two phases: the one, a neoplastic, in the sense of being a new formation of cells of a less differentiated type; the other, a true metaplastic phase—the differentiation of these cells in a new direction, i.e., into a tissue genetically related. In osteitis fibrosa these two phases are represented by the reversion of the cell content of the Haversian system to embryonic cells, the great majority of which differentiate into fibroblasts and lay down fibrous tissue. New bone arises in this fibrous tissue by metaplasia from these fibroblasts, either directly (reticular bone) or through an intermediate form of osteoblasts, which are also of fibroblast descent (apposition bone). In this connection it is important to remember the specific osteogenic influence exerted on connective tissue cells by calcium salts, which may be derived from the resorbed bone."

Limitations of space in the Journal preclude the possibility of publishing an adequate abstract of this work and this brief notice is published in order that our readers may not miss a very important contribution to a subject of which our knowledge is still fragmentary and incomplete.

A copy of the issue of the Edinburgh Medical Journal containing this article may be obtained from its publishers or through the publisher of the American Journal of Roentgenology and Radium Therapy.

It is with great regret that we announce the death of Dr. Park P. Brenneman of Lancaster, Pa., on March 23, 1924.

An account of his life will be published in the next issue of the Journal.

Subscribers to The American Journal of Roentgenology and Radium Therapy *visiting New York City, are invited to make the office of* The Journal *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

THE TWENTY-FIFTH ANNIVERSARY OF THE DISCOVERY OF RADIUM

The discovery of radium by the Curies was officially announced to the world in a paper read before the Academy of Sciences of Paris on December 26, 1898. The twenty-fifth anniversary of this momentous event in the progress of science was appropriately celebrated in Paris on the initiation of the Curie Foundation. The writer happened to be in Paris at the time, and was kindly invited to take part in the celebration.

The principal ceremony took place at the Sorbonne and was presided over by President Millerand. The program was as follows:

1. *La Marseillaise,* played by the band of the Republican Guard.

2. *Allocution by M. Paul Appell,* Rector of the Academy of Paris and President of the Curie Foundation.

3. *Polonaise Number* 4 (Chopin), played by the band of the Republican Guard. The sentimental appropriateness of this selection is obvious since Poland is Madame Curie's native country.

4. The presence of Professor Lorentz, who came from Leyden to take part in the ceremony, caused a change in the program. President Millerand called on the eminent Dutch physicist to speak at this point. In very good French he brought out clearly the importance of radioactivity in modern physics, its relation in the unification of chemistry and physics and the part played in the determination of atomic structure.

5. *Conference by M. Jean Perrin, "Radioactivity and Its Importance in the Universe."* Professor Perrin compared the advent of radioactivity to the conquest of fire by primitive man. He then reviewed the salient points of the discovery and of the properties of radioactive substances, emphasizing the transmutation of one element into another and mentioning the possibility of being able to do this at will in the future.

6. *Reading of the significant passages in the scientific communications of the Curies* in which the initial discoveries relative to radioactive bodies were originally announced to the Academy of Sciences. Very appropriately these excerpts were read by M. André Debierne, who was associated with the Curies in the early days of the work, and has continued his collaboration with Madame Curie. To the physicist this was the most dramatic part of the program. It gave a vivid picture of the different steps which culminated in the discovery of radium.

7. *Some Fundamental Experiments.* These were made by M. Holweck and Mlle. Irene Curie of the Curie Laboratory. They were executed most successfully, and impressed the audience greatly. The first was the discharge of a gold leaf electroscope by radium radiations, demonstrating the ionizing property of the rays. The second illustrated the random emission of alpha particles. In this experiment use was made of a radio-telephony amplifying system and loud speaker to "announce" the arrival of one alpha particle in a suitable ionization chamber. A so-called "radium clock" was then shown. The last experiment consisted in allowing radium emanation to diffuse into a glass tube coated with zinc sulfid which became phosphorescent, due to the bombardment of the alpha and beta particles.

8. *Conference by Dr. Antoine Beclère, "Radium and Medicine."* In his address Dr. Beclère outlined the rapid progress of radium therapy and the important place which it now occupies in the treatment of malignant disease. *Le Temps* of December 27 quoted the following vivid passage: "Formerly surgery was the only means to combat cancer. To-day there is a happy competition between radium and *x*-rays and the surgeon's knife. These radiations represent so many *bistouris,* or rather invisible arrows, wonderfully sharp and piercing, which riddle the whole diseased region and, without bleeding or mutilation, without injuring the skin, they kill

in a deep-seated organ the cancer cells, leaving the neighboring normal cells intact."

9. *President Millerand called upon Madame Curie to talk.* She arose amid enthusiastic applause, and was evidently deeply moved. In a very low voice she spoke of her work, paying tribute to the genius of Pierre Curie. Speaking of the discovery of Radium she said: "It was a most modest enterprise undertaken by two humble beings anxious to serve. Started in the old School of Physics where we could not find proper facilities, we were worried with difficulties which at times seemed insurmountable. We continued in spite of difficulties in order to realize an ideal which made us slaves to science. The discovery of radium was made under the most precarious conditions in a humble building that has since become legendary. Of the benefits which resulted therefrom one of us did not profit. Pierre Curie left us several years before the creation of the laboratory which bears his name. But we know that the rule of his life was to go on with his work no matter what happened, and according to his own fine expression 'to make of life a dream and of a dream a reality.' It is gratifying to know that by an unhoped-for good fortune, our discovery has helped to relieve human suffering."

10. *Address by M. Léon Bérard,* Minister of Public Instruction. M. Bérard said he could not speak of the discovery of radium as a scientist but he was happy to bring to Madame Curie the enthusiastic homage of the French Parliament. He spoke of the philosophical aspects of the great discovery, and paid tribute to science and the unselfish devotion to the search for truth of scientists such as Madame Curie.

11. *Allocution by President Millerand.* President Millerand recalled the visit which he, in the capacity of Minister of Commerce, paid to the poorly equipped laboratory in which the Curies were carrying out their pioneer work, soon after the announcement of the discovery of radium. He mentioned the profound impression which M. and Mme. Curie made upon him. In conclusion he said: "The Government of the Republic, and Parliament as faithful interpreters of the people's thoughts, have already offered Madame Curie a concrete national recompense.[1] May she receive it with the solemn homage which we pay her today as a sincere token of the universal sentiments of enthusiasm, respect and gratitude, in which she is held."

12. *A march played by the band of the Republican Guard* ended the ceremony.

One of the touching episodes of the afternoon was the presentation to Madame Curie of a winged Victory in bronze, by a representative of the student body of France. Also the Belgian students were represented by a delegation of 120 who arrived in Paris unexpectedly. They offered their tribute in flowers.

It is hardly necessary to say that the *élite* of the intellectual aristocracy of France were present *en masse.* Seats had been reserved on the stage for them and the representatives of foreign learned societies and institutions. From America, in addition to the writer, there were Professor Noyes representing the American Chemical Society, and Dr. Gendreau representing the Université de Montréal (Canada).

OFFICIAL INAUGURATION OF THE CURIE FOUNDATION

Since the Curie Foundation is practically unknown in this country, it is perhaps well to give a brief outline of its historical development. In 1912 the University of Paris and the Pasteur Institute in close cooperation founded the Radium Institute. In the years 1912–1914 two modern laboratories were built, to be devoted separately to chemical and physical researches and to biological studies of radiation. The former is an intrinsic part of the University of Paris and is directed by Madame Curie. The latter bears an analogous relation to the Pasteur Institute and is under the directorship of Dr. Cl. Regaud. The war came before the laboratories were even fully equipped and their work came to a standstill until the end of 1918. At this time, however, the work was taken up with renewed zeal, and rapid progress has been made.

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[1] This refers to the yearly allowance of 40.000 francs which the Parliament had voted to Madame Curie a few days previously

Since the Pasteur Pavillion is devoted to purely scientific investigations, the need soon arose for a suitable place in proximity to the laboratory where patients could be treated properly. It was to supply this need that the Curie Foundation came into existence. It is a private organization which has undertaken to supply means to the Radium Institute for scientific research, and particularly for the therapeutic applications of radium and roentgen rays. The Foundation was recognized of public utility by official decree in May, 1921, and has enjoyed since the support of the government.

The president of the Board of Directors is M. Appell, Rector of the University of Paris; the vice-presidents are Dr. Roux, Director of the Pasteur Institute, and Madame Curie; the treasurer is Dr. Henri de Rothschild, one of the founders; the secretary is Dr. Regaud, Director of the Laboratory of Radiophysiology of the Radium Institute.

The Foundation has at the present time a dispensary adjoining the Radium Institute, a Department at the Pasteur Hospital, and a Department at the Medico-Surgical Clinic. The Dispensary consists of two two-story buildings. One, the Rothschild Pavillion, is devoted to radium therapy, and the other to roentgen therapy and diagnosis. No wards or rooms for the hospitalization of patients are available here, so that patients needing hospital care must be taken by ambulance to the two above-mentioned departments in other institutions. This is a serious disadvantage, which is felt keenly by the staff, and steps are being taken to correct it. The two buildings are very well arranged and equipped. For radium therapy 2700 mgm. of radium element are available. A considerable part of this is in solution for the preparation of emanation; the rest is used in fixed needles or tubes. The roentgen-ray equipment consists of six high voltage machines of the latest design, from which a total of eight roentgen-ray tubes can be run simultaneously.

It will be of interest to American women who donated 1 gm. of radium to Madame Curie to know that this radium is kept in the Curie Laboratory and used exclusively for experimental work by Madame Curie and her co-workers. Before she received this gift she had practically no radium, because in 1918 she had given the Curie Foundation the gram which she had prepared herself from Bohemian ores. This was in accordance with her husband's wishes, for they had agreed that they should get no personal material advantage from their discovery.

Other contributions to the supply of radium at the Curie Foundation were made by Dr. Henri de Rothschild and by the French Government.

A number of fellowships, of the value of 12,000 francs each, are available annually. They are awarded to properly qualified research workers to carry out in the laboratories of the Institute investigations relative to the biological actions of the radiations or to the radio-treatment of cancer.

Indigent patients are examined and treated gratis; to others a reasonable charge is made, payable to the Foundation. The medical staff cannot collect fees from patients treated as private patients.

The Curie Foundation had functioned for a considerable time but the formal inaguration was reserved for the morning of December 26. M. Paul Strauss, Minister of Hygiene, presided over the meeting. M. Appell spoke first. He praised particularly the Minister of Hygiene for his efforts in organizing in France a systematic fight against cancer by the establishment of regional centers, of which the Curie Foundation is the most conspicuous one. He thanked Madame Curie for her generous gift of 1 gm. of radium, and all those who had made financial contributions. Finally he praised Dr. Regaud, whose disinterested devotion to the work has made its rapid development possible. Dr. Regaud then explained the practical functioning of the Foundation.

Professor Bergonié, one of the pioneers of radiation therapy, paid a tribute to Madame Curie and recalled with emotion that it was in his laboratory in Bordeaux that she deposited her radium in September, 1914, at the time when it was feared Paris would be captured by the Germans.

M. Strauss took this occasion to thank all those who had cooperated with him in his efforts on behalf of the cancer patient. He announced then that Parliament had voted unanimously 5,000,000 francs for the purchase of radium.

A tour of inspection through the two buildings concluded the program.

DINNER GIVEN BY DR. HENRI DE ROTHSCHILD IN HONOR OF MADAME CURIE

The Rothschild family have been interested in radium since the beginning of the work. In the early days they were influential in securing some of the Bohemian ores needed by the Curies. Dr. de Rothschild has established a fund of 200,000 francs for the Curie Foundation and has contributed 400,000 francs for the purchase of radium. The celebration of the twenty-fifth anniversary of the discovery of radium was completed in the evening by a dinner at his house, given in honor of Madame Curie. There were probably more than one hundred guests, including high government officials and the leading men of science in France. Madame Curie was very happy and cheerful the whole evening. In spite of the strenuous day she had had, she remained until a late hour.

G. Failla.

Memorial Hospital, New York City.

MEETING OF THE CENTRAL SECTION

The Central Section of The American Roentgen Ray Society held its fifth annual meeting in Indianapolis on February 23, 1924, with Dr. D. Y. Keith, of Louisville, Ky., as chairman and Dr. Raymond C. Beeler, of Indianapolis, as secretary.

There was not a large attendance at the meeting and this made it possible to make the discussions very informal and to conduct most of them in the nature of a round table. The educational value of such discussions can hardly be over-estimated and it would be well if, in our larger gatherings, this method could be used by dividing those in attendance into small groups. Dr. Case, for instance, gave one of his usual clear and comprehensive talks on "Colonic Diverticulosis" showing roentgenograms and photographs of the specimens, and Dr. Crane discussed, in a most instructive way, "The Early Diagnosis of Pulmonary Tuberculosis" pointing out the signs of the disease upon the original films.

The forenoon was devoted to diagnostic subjects and the afternoon to therapeutics. During the afternoon session Dr. D. Kahn, of Toledo, read a paper on "Treatment of Diphtheria Carriers by the Roentgen Ray." His results were generally good and in agreement with those of Dr. Hickey, published previously in this Journal.

The papers will be available to our readers through publication in the Journal at a later date.

The following officers were elected for the ensuing year:

President, Dr. B. R. Kirklin, Muncie, Ind.; 1st Vice-President, Dr. J. T. Murphy, Toledo, Ohio; 2nd Vice President Dr. George Thomas, Cleveland, Ohio. Secretary, Dr. Wm. A. Evans, Detroit, Mich.

ANNUAL MEETING OF THE ROENTGEN RAY SOCIETY

The next meeting of the American Roentgen Ray Society will be held at the New Ocean House, Swampscott, Massachusetts, on September 3, 4, 5, and 6, 1924.

Members wishing to take part in the program are requested to send the title and a brief abstract of their paper to the President-Elect, Dr. George W. Holmes, 265 Charles Street, Boston, Massachusetts, before June 15th.

THE CALDWELL LECTURER, 1924

Announcement has been received from Dr. Holmes, President-Elect of the American Roentgen Ray Society, that Dr. Goesta Forssell of Stockholm will deliver the Caldwell Lecture at the annual meeting of the American Roentgen Ray Society to be held in Boston on September 3, 4, 5 and 6.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

ROENTGENOGRAPHIC CHEST TECHNIQUE

BY HOMER L. SAMPSON

TRUDEAU, NEW YORK

TECHNIQUE may be divided into two main subjects: first, roentgen exposure; second, the dark-room developing process.

Under the first heading there are many factors, the combination of which is preliminary to the finished result. These factors vary in value. Some are necessary and may be used in different combinations, while others are more or less factors of choice. These, arranged somewhat in the order of their importance, are the current strength, indicated in milliamperes; the exposure time, seconds; the type of tube employed; intensifying screens, used or not used; stereoscopic or single roentgenograms; use of films or plates; use of the Potter-Bucky diaphragm; the phase of respiration in which the exposure is made; the position of the patient; the direction of tube shift; and diaphragming.

Any recommended technique reminds one of the "radio bug" who thinks his "hookup" is the best. It is probably the best for him because he has learned how to handle it. So it is with roentgen techniques; there are many, and, in the hands of the respective operators, produce good results. The important factors to bear in mind are that the finished film or plate should be full of detail, of moderate contrast and without objectionable distortion. Exposures beyond four or five seconds make it difficult to obtain a film in which the patient has not moved or breathed. However, good results can be obtained with three seconds, or less; which would mean less than seven seconds for stereos. The writer has found it a distinct advantage to keep all factors constant except the time of exposure, which is varied according to the depth of the chest. The writer wishes to emphasize the value of selecting only one of the exposure factors as a variable. The prime object of "locking" (so to speak) all the factors but one makes it possible to obtain uniform results in different subjects, and in the same subject at a later date, this latter feature

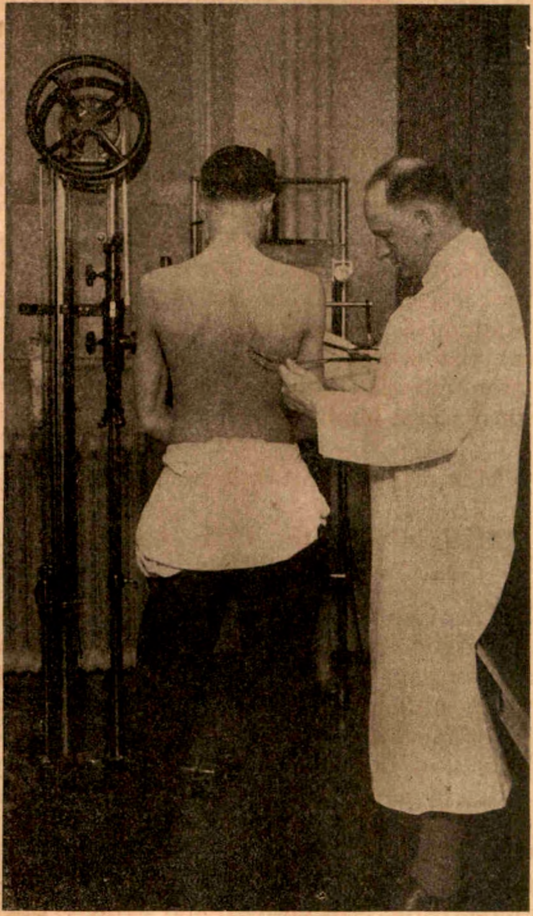

FIG. 1. Calipering or measuring the chest. The measurement is made at about the level of the third rib anteriorly and the exposure based on this.

being very valuable in comparative chest work.

The patient is centered over a vertical line. In the illustrated changer the supporting chain furnishes this guide. In height, the tube is centered at about the angle of the scapula and the tube shifted from above downward 1⅛ inches, above and below this point. With the gravity shift there is practically no movement of the tube after the shift has been made; and this gives, in the resulting films, the advantage of looking around the ribs, so to speak. The upright position is more comfortable for the patient and attended with less nervousness. The patient's hands are reached well around the changer to remove the scapula shadows from the lung field. This position also helps to eliminate movement.

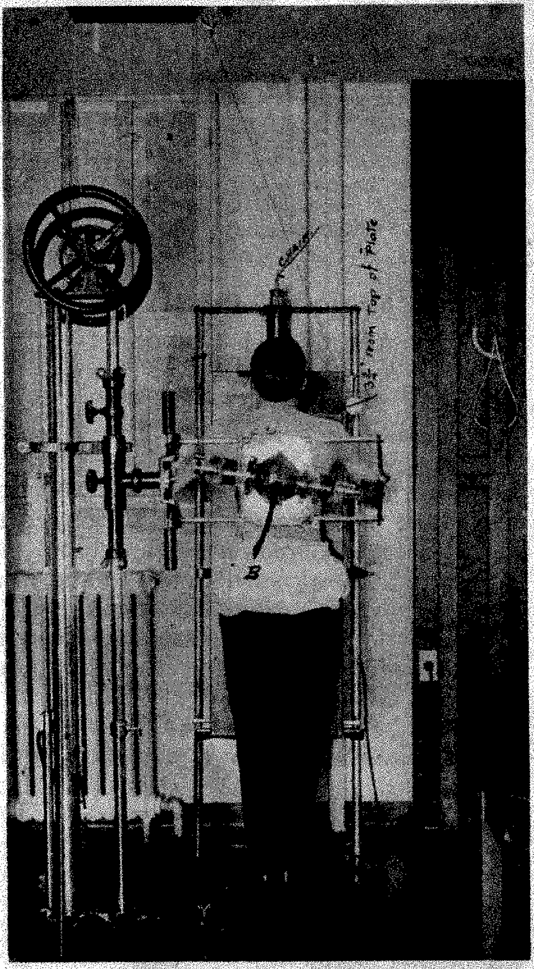

FIG. 2. The line A is about level with the apex of the lung: The patient is centered laterally with the chain on the plate changer. The tube for the first film is about 1¼ in. above the center of the film, shifting to 1¼ in. below center. The lower angle of the scapula is a trifle lower than the middle of the film. The relation of tube, patient and film is judged from sighting point B.

STANDARDIZATION

The value of standardized work of this character is fully demonstrated. Knowing the spark-gap, milliamperage, distance, and the time of development before hand, removes these from the field of calculation; the time of exposure being the only variable. On a basis of such reckoning, we should be able to produce the same quality of film regardless of the interval of time. Though this ideal is not always reached, very uniform results are obtained by this method.

After the films have been made, proper photographic handling is the next step. Too much emphasis cannot be placed upon proper development, as many a perfectly exposed film has been spoiled in the dark room. A properly exposed film will come out all right if the time of development at the given temperature is followed. If you know the film was over-exposed, shorten the developing time, and vice versa; remembering that you cannot produce a shadow on an underexposed film, where it never existed. In consequence of this, it is usually safer to overexpose rather than underexpose. Standardizing the work in the dark room, i.e., developing the proper length of time for a given temperature, is a good check on the work done in the laboratory and almost always reveals faults in exposure.

By constantly watching and checking up errors the variable factor can be handled satisfactorily.

The following technique has been very satisfactory in our chest work.

(C denotes Constants)

C5–5¼"	Spark gap measured at the tube, between moderately sharp points, registering on a sphere gap at 65 k.v. app.
C30 ma.	Current.
C30"	Tube-film distance.

Time — Varies according to depth of chest, as follows:

Depth (cm.)	Time (sec.)
12	.6
13	.7
14	.8
15	1.
16	1.1
17	1.3
18	1.4
19	1.6
20	1.7
21	1.9
22	2.1
23	2.4
24	2.6
25	3.
26	3.4
27	4.

C Tube — 30 ma. radiator type

C Films — Duplitized super-speed, without intensifying screens. (With screens ⅛ to ⅙ the time.)

Development—Eastman powders. 65° temperature 6 minutes, increasing the time as the developer weakens from use; also increasing the time for a cooler solution; decreasing for a warmer. Limits of temperature of solution, 60° to 70°.

The constants or standards and variable can be worked out for different parts of the body

Editor's Note: Mr. Sampson has not mentioned a metal marker permanently fastened to his stereo film changer, in such a manner that its shadow is left upon an upper corner of the first film of each pair exposed. The corner so marked serves as an indicator for correctly placing the pair in the stereoscope. If, for instance, the marker is over the upper right corner of the first film its shadow will belong in the upper back corner of the left hand view box. A real time saver.

D. R. B.

SOME CAUSES OF POOR CONTACT BETWEEN INTENSIFYING SCREENS AND FILM

BY R. B. WILSEY

ROCHESTER, NEW YORK

It is well known that firm contact between intensifying screens and film is essential for the best roentgenographic definition. In double screen technique, nearly the whole photographic effect is due to the fluorescent light from the screens, and any lack of contact between the fluorescent image and the film is sure to result in blurred outline in the roentgenograph. In the roentgenography of thick parts, the loss in definition due to the inherent limitations of the screens is, for most types of screens, negligible in comparison with the effects of poor contact, scattered radiation, and the effect of size of focal spot combined with the distance of the part rayed from the film.

Experiments with a new method of testing screen contact have shown some of the causes of poor contact, and indicate the ways by which good contact may be obtained. In this test a screen is ruled with cross lines; a cleanable screen may be ruled with a grease pencil and the lines washed off afterward, or an old screen may be ruled with ink.[1] A flash exposure made with such a screen shows the rulings as clear lines on a dark background, the sharpness of the lines depending on the closeness of the contact between screen and film.

Figure 1 shows such a test made in a cassette having a rigid back lined with a thin hard felt. The cassette had been in use for several years and the aluminum front had become permanently bulged out. The test shows clearly the effect of this upon the contact between screen and film; the contact is good at the edges of the film but very poor over the central area. The padding on the cover of the cassette was then reinforced with a layer of thick soft felt and the test in Figure 2 was obtained; the contact appears quite good over the whole area of the film.

Similar results were obtained in other tests. A new cassette of another type, with rigid back and thin felt padding, gave better contact than the first cassette, but the test also showed an irregular area of poor contact in the center. Several cassettes with thick felt padding on the cover all gave good contact over the whole area of the film regardless of whether the cover was rigid or slightly flexible. Evidently the thick layer of felt serves to compensate for the differences in the surfaces of the front face of the cassette and the cover, so that sufficient pressure is exerted over each portion of the screen to give good contact everywhere. An air cushion should give completely uniform pressure over the whole cassette, regardless of irregularities in either the front face or the cover.

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[1] This test was suggested to the writer by Mr. F. C. Martin of the Medical Division, Eastman Kodak Company.

The usual practice in cassette design is to make the cover rigid, whereas the thin aluminum face of the cassette cannot be made rigid no matter how tightly it is stretched over the frame, with such a cassette the contact depends largely on the character of the padding on the cover. It would seem more logical to attempt to make a cassette cover that under the pressure of the springs would assume nearly the same form as the front face, and use a layer of felt or other padding sufficient to compensate for the small irregularities between the two surfaces. In addition to being slightly flexible, the cover might possibly be formed with a slightly convex surface; the exact form of surface and degree of flexibility would, of course, have to be determined by experiment.

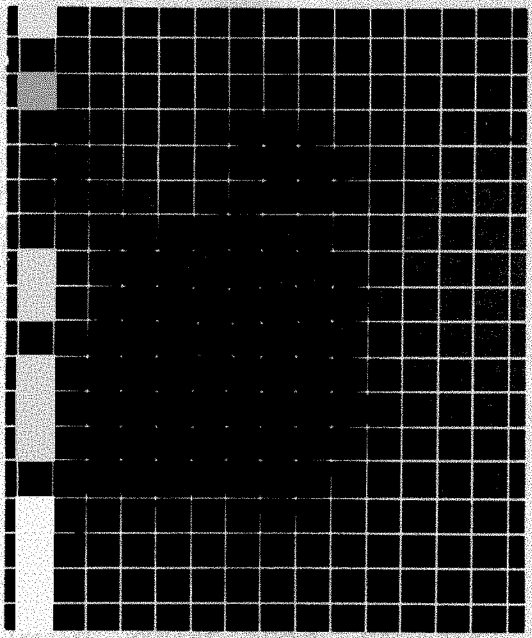
FIG. 1. Test of contact between intensifying screen and film in cassette with rigid back padded with thin hard felt. The test shows poor contact in central area.

For convenience in using the cassette, the cover should preferably be hinged permanently to the cassette in a manner that allows for variations in the thicknesses of screens; in loading the cassette, the screens and film should fall automatically into the correct position without the necessity of adjusting them; for this reason, the straight sides as illustrated in Figure 3a are preferable to the ledge, as shown in Figure 3b. In addition, the cassette should be made as light and thin as is consistent with substantial construction.

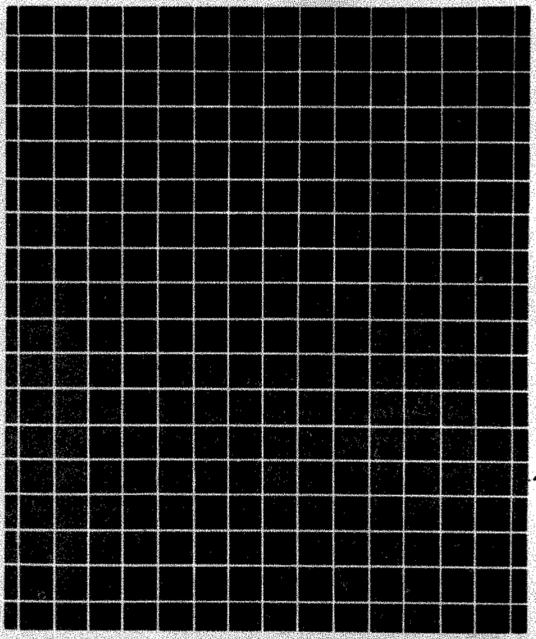
FIG. 2. Contact test with same cassette; the padding on the cover has been reinforced with a layer of thick soft felt. The test shows good contact over the whole film.

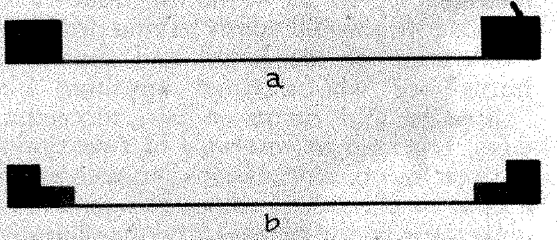

FIG. 3. For convenience in loading, the cassette should have straight sides as illustrated in cross section at (a). The ledge shown at (b) gives difficulty in adjusting screens in correct position.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

The Effects of Radium Upon Living Tissues. By Sidney Forsdike, M.D., B. S. Lond., F. R. C. S. Eng. Surgeon to Outpatients, Hospital for Women, Soho Square; Gynecological Surgeon to the Kensington and Chelsea General Hospital. Price $2.00. Pages 72. Paul B. Hoeber, Inc., New York, 1923.

The seventy-two pages of this volume cover very adequately the history, animal experiments, clinical application, and conclude with the statement that "Radium has won its spurs in clinical medicine by virtue of its effect upon malignant tumors."

The author's query "Are we to continue to treat only inoperable cases?" is answered by his plea for radium treatment in early cancer of the cervix.

The concluding chapter is devoted to "The Treatment of Severe and Persistent Uterine Hemorrhage by Radium, with a Report of 45 Cases" which constituted a paper read before the section of Obstetrics and Gynecology of the Royal Society of Medicine in March, 1923.

His reasons for employing radium to the exclusion of the roentgen ray in such cases will not be accepted by the well-informed roentgenologist. It would be difficult to find one who would admit having produced "ulceration of the bowel and superficial burns" or who devoted anything like "three to four hours on two succeeding days, repeated at intervals of twenty-one days on four to six occasions" to accomplish a cure in uterine bleeding. His remaining objections to the roentgen ray are likewise not well founded.

Generally speaking, however, the book constitutes a satisfying epitome of the subject covered by the title.

Atlas typischer Röntgenbilder vom normalen Menschen. (Atlas of typical roentgenograms of the normal individual.) Lehmann's med. Atlanten. Band V. 4th Ed. Bound. Price, $4.70. J. F. Lehmann, München., 1923.

This valuable atlas, after a lapse of five years, has now been published in a new edition. As an excellent book for study, it may be recommended to beginners in roentgen diagnosis; and experienced roentgenologists can consult it with profit because of its value as a reference work. New illustrations have been introduced, and some of the former ones replaced. (It seems to the reviewer that Tables 24 and 25 might have been revised.) The picture of the growing bony system, and in the field of vertebral spinal system, the sketches of oblique exposure all deserve recommendation. The ossification tables are valuable for ready reference. It may therefore be said that this volume is of value as a reference work and has the additional virtue of interesting presentation.

G. F. Haenisch.

BOOKS RECEIVED

Scientific Rejuvenation Without Operation. By H. H. Rubin, M.D. 64 pp. New York: Medical Science Publishing Co., 1923.

Radium, X-Rays and the Living Cell. By Hector A. Colwell, M.D. (Lond.) D. P. H. (Oxfd.) and Sidney Russ, D. Sc. (Lond.), F. Inst. P. 365 pp. London: G. Bell and Sons, Ltd., 1924.

The Biology of the Internal Secretions. By Francis X. Dercum, M.D., Ph. D. Price $2.75. 241 pp. Philadelphia and London: W. B. Saunders Company, 1924.

Radium Report of the Memorial Hospital, New York. (Second Series, 1923.) Price $5.00. 305 pages, with 55 illustrations. New York: Paul B. Hoeber, Inc., 1924.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

GUNDERMANN. On the treatment of peripheral roentgen ulcers by periarterial sympathectomy. *Beitr. z. klin. Chir.*, 1923, cxxix, 231.

Ten per cent NaCl solution compresses, ointment bandages and caseosan injections failed to overcome pain and stiffness of the hand from roentgen ulcer. Periarterial sympathectomy of the brachial artery was made. The next day the hand could be moved, the ulcer diminished and the patient who had been staying in bed on account of pain desired to get up. After five or six months the ulcer was covered over, and epithelialized.

Another case of roentgen ulcer at the right elbow was cured by dissecting loose the arteria and vena axillaris for 6 to 8 cm. from their sheaths. While this was being done several branches from the medianus and the ulnaris which entered the sheath were severed. Two hours after the operation the hand felt much warmer and the pulse was stronger. The pain was gone by evening.

Periarterial sympathectomy the author contends will have a prominent place in future dealings with roentgen ulcers. He does not attempt to find the explanation of the process causing the improvement, and makes only a few conjectures which he however does not consider conclusive.

HOERNICKE, C. B. Roentgen treatment of bone and joint tuberculosis. *München. med. Wchnschr.*, 1923, lxx, 943.

Iselin proposed maximum radiation for bone and articular tuberculosis. Later he used less than the erythema dose for fear of ulceration. Generally one-third of the cutaneous erythema dose is used. This is a dose which, after eight days, causes slight reddening of the radiated skin, and brown discoloration after four weeks. Where abscess or fistula exist, small doses must be given. Some fibrous forms cannot be influenced. They must be treated with up to 60 per cent of the cutaneous erythema dose. Within six weeks one will increase up to a maximum of one cutaneous erythema dose. After three treatments an intermission of three months should be made. Aluminum, copper, or zinc are used according to the depth of the focus, and the type of the skin. Simultaneously, general orthopedic treatment should be given, particularly where other tuberculous foci exist in the body. Where splints have to be resorted to on the lower extremities, they ought to be changed every six weeks. Tuberculin sensibilization of the focus may be of good effect, as it may cause hyperemia.

Surgery cannot be entirely replaced by roentgen ray in bony and joint tuberculosis.

The customary doses have no influence upon healthy bone and cartilage, while tuberculous granulations are hypersensitive to roentgen rays. If granulations surround a bony lesion, they will be sequestered out. A cavity with sharp borders will remain. It will fill in very slowly with bony tissue.

HOLFELDER, HANS. Experiences with roentgen therapy for malignant tumors in Schmieden's Clinic. *Strahlentherapie*, 1923, xv, 715.

Indications for the roentgen treatment of tumors cannot be generally given because in each case the type of tumor and other circumstances must be taken into consideration. In Schmieden's Clinic every operable carcinoma with very few exceptions is operated upon and subsequently treated by roentgen rays prophylactically, unless the patient declines it, or the operator has some scruple. Aside from this prophylactic postoperative radiation, a preoperative intense radiation has gained more and more ground. As far as possible, all inoperable carcinomata and all inoperable recurring tumors are radiated. In some cases a clinical cure can be affected, in others a possibility for operation can be obtained. In other instances, the danger of hemorrhage will be diminished, and also pain and putrefaction, and the danger of further metastases. In facial carcinomata where the operation and transplantations have yielded unsatisfactory cosmetic results, roentgen rays will often correct the effect. The great majority of sarcomata are treated with roentgen rays, especially where operation would produce intense disfigurement. One must not be misled by a proliferation of growth immediately subsequent to radiation. As the indications of this clinic are closely drawn, the material is composed mainly of inoperable cases, or of prophylactically treated patients. During the time of November, 1919, until November, 1921, 43 cases of operable mammary carcinoma were radiated prophylactically after operation. Thirty of these patients are now alive, and show no recurrence. This amounts to 70 per cent. One patient died six months after operation from pneumonia, and no carcinoma was found at postmortem examination. Twelve cases had recurrence or metastases. Nine have died. Recurrence and metastasis occurred within fourteen months, on an average, or as a maximum, twenty months.

During the same period, 51 cases of rectal carcinoma were treated. Fifty-seven per cent of these were inoperable. Five of these became operable by using roentgen rays on the anus. Twenty-nine and one-half per cent are still alive, and better, while other operative statistics give only 10 to 12 per cent with three years' freedom from recurrence. Thirty-two cases died in consequence of this disease.

In gastric carcinoma the stage of experiment has not yet been passed, either in a curative or in a prophylactic sense. It is necessary to eliminate accessory damages before applying roentgen rays in stomach neoplasms. Somewhat of an improvement was arrived at two and one-half years ago, by avoiding the adrenals. Of 12 cases on whom a radical operation was performed, and who were radiated prophylactically after operation, three beyond doubt are still living. However, the time of observation is too short to permit any conclusions. Among 5, where operation was not radical, and radiation employed after operation, only 1 is definitely known to be still living without discomfort. Among the 24 inoperable cases of gastric carcinoma, where roentgen rays were applied therapeutically, none is living without discomfort. All that can be said about radiation of gastric carcinoma is that it is a method which may be used in sensitive patients, without much discomfort.

Seven cases of mediastinal tumors are reported. Four of them died, and 2 are much improved and still living, and 1 of them is cured, and has no discomfort. Among 6 cases of lymphogranulomatosis, 5 showed good temporary results for a year; 4 of them, however, have died, and 2 are still being treated for recurrence.

Klare, K. and **Dehoff, E.** D'Espine's sign and roentgenogram. *Ztschr. f. Tuberkulose,* 1923, xxxviii, 260.

One of the most valuable diagnostic aids is d'Espine's sign—spinal auscultation of the whispered voice. It has been used by the author in 400 cases simultaneously with roentgenograms in bronchial glandular tuberculosis. Bronchophony is marked and masses of intumescent shadows in the hilus were found in 130 cases, or 32.5 per cent. A weak or no whisper with old calcareous foci and negative roentgenograms, that is such that did not show the usual signs of active tuberculosis in 204 cases, or 51 per cent. In 9.3 per cent the symptoms could not be clearly interpreted. In 7.2 per cent there was no accord between d'Espine's sign and the roentgenogram.

Lind, S. C., and **Bardwell.** The coloring of the diamond by radiation. *J. Frank. Inst.,* Oct., 1923, cxcvi, 521–528.

The diamond is colored green, when exposed to the direct radiation from radium, which color is removed by heating to 500° C.

Recutting the stone removes the color, perhaps from the heat generated in the polishing; the carbon spots produced are also removed by heat.

Dr. Lomon. Method permitting the taking of successive roentgenograms in the course of, and subject to the control of roentgenoscopy. *Bull. et. mem. de la Soc. de Radiol. Med. de France,* July, 1923, 210.

The method of which this communication is the object permits in the course of a roentgenoscopy made with the aid of a screen of normal dimension the taking of roentgenograms under the control of roentgenoscopy. These can be as numerous as may be desired. Roentgenoscopy is not subjected to any modification of technique from the employment of this apparatus.

The apparatus has the appearance of an ordinary roentgenoscope about 40 × 40, and is not sensibly heavier or thicker than the usual screen. The back part of the screen has a double bottom perfectly permeable to the roentgen ray with the exception of a plaque 13 × 18 (placed in part in the length of frame), which is doubled with lead.

The free space reserved by the double bottom permits an aluminum carrier, mounted on an axle and controlled by a lever, to be placed by the axle of a lever in the upper left region or in the central part of a roentgenoscope An opening in the frame of the apparatus permits to slide into the chassis a special film carrier. These film carrier-cassettes (aluminum) are thin, presenting no external obstructions and take the films with or without the screen, assuring a uniform pressure, depending upon the thickness of the support chosen.

Milani, E. Clinical and roentgenological observations on the so-called hypertrophic pulmonary osteoarthopathies in the tuberculous. *Rass. int. di clin. e ter.,* 1923, iv, 377.

Drumstick fingers were formerly considered a sign of pulmonary trouble only, but it was later found that patients suffering from chronic heart disease, as well as those with subclavian aortic aneurysm, and mediastinal granulomatosis, spinal vertebral disease, carcinoma of the esophagus, chronic pyelonephritis, and icterus presented them likewise. They are also found in bronchitis, bronchiectasis, tuberculosis, pulmonary cancer, and emphysema.

Often the distal bones are enlarged in pulmonary disease. A few authors who studied the nails and finger-tips, roentgenologically, however, found them normal in size.

The author studied 450 patients who had Koch bacillus. He found 51, that is, 11.3 per cent digital deformities. In 10 out of 17 patients with these deformed finger-tips, cavities were found in the lungs, clinically and roentgenologically. These changes in the fingers were not as frequent in broncho-alveolar conditions and in sclerosis. (Eight cases out of two hundred eleven.) In the ulcerative forms, 24 were found among 108. The author considers these changes as existing more in the soft parts, and that the phalangeal development is somewhat changed.

Moorhead, T. G. Remarks on hyperthyroidism. *Irish J. Med. Sc.*, 5th series, No. 15, May, 1923, 107–118.

In cases under medical treatment, the gain in weight is the first and most important result. When treatment is successful the weight soon steadies, and in a few weeks begins to go up. Till an increase is registered, one cannot feel that progress is being made.

Secondly, there is a diminution of the tachycardia. In the process of recovery, tremor, sweating and other symptoms lessen pari passu with the gain in weight.

The treatment adopted is as follows:

1. The patient must go to a nursery home for the first month. The work cannot be done in the home of the individual.
2. During the first week, the patient remains rigidly in bed. An ice bag is applied to the thyroid gland at least two hours daily. Diet largely vegetarian. Sedatives at night, if required. Very few visitors allowed. Quinine bromide, 5 grains, given three times a day, and any local septic foci eliminated.
3. During the next three weeks, the same regime is followed, the patient receiving, in addition, a roentgen-ray treatment over the thyroid and thymus regions. The dosage is for the roentgen-ray expert, and none but experts should be consulted in any case.
4. At the end of the month, the patient can return home for a month, going easily, not getting up until after lunch, and taking only short walks.
5. After this month at home, a second three weeks roentgen-ray course is carried out, this being best done in the Nursing Home.

At the end of the first three weeks, the patient is as a rule, more comfortable. When the treatment is over, there is an enormous gain all around, and at the end of six months from the beginning of treatment, the patient should be perfectly well. The goiter, as a rule, becomes hard and fibrous; and the process of fibrosis may continue for long after the treatment is finished. The results are as good as those of surgery without its dangers. "Hale White, and other writers have emphasized the fact, that operation only too frequently is not a certain cure—and inasmuch as it is uncertain and is not safe, I prefer the course that is uncertain, but safe."

Murphy, Jas. B., Maisin, Jos., and Sturns, E. Local resistance to spontaneous mouse cancer induced by *X*-rays. *J. Exper. M.*, Nov., 1923, 645–653.

Careful experiments indicate that the lethal doses for transplanted mouse and rat tumors, are rarely, if ever, within the therapeutic dose for man. On the other hand, certain forms of cancer are cured by roentgen rays.

The fact that cancer cells are not easily killed by roentgen ray and yet cancer may be cured by this agent, requires examination if it is to be developed into a more effective form of treatment.

It has been shown that an erythema dose of roentgen ray renders the area highly resistant to inoculated cancer. As transplantable tumors were used for these experiments no general deduction can be drawn concerning the behavior of spontaneous disease.

In experiment one, a mouse with a spontaneous mammary cancer, was operated on with removal of the tumor. With the tumor removed an area on the left flank, 12 × 15 mm., was exposed to an erythema dose of roentgen ray, with the following factors; Spark-gap, 3 in.; ma. 10; distance 6 in.; time, 2½ min.

Immediately after this treatment a small bit of the original cancer was reinoculated intracutaneously in the roentgen-rayed area, and a like graft in the right flank, which had been protected from the roentgen ray. Among forty mice, with various types and stages of mammary tumors, subjected to this treatment, the inoculated graft in the irradiated region failed to grow in 35, or 71.4 per cent, while the graft in the untreated area, failed in only 8, or 16.4 per cent. Those that grew in the irradiated area, grew much more slowly than those in the non-irradiated area, so that on the death of the animal it was not more than a fraction of the size of the other tumors.

From these experiments it is evident that the local immunizing effect of the roentgen ray is just as effective against autografts of spontaneous tumors as it is against transplants of transplantable tumors.

Will the conditions induced by roentgen rays, be sufficiently unfavorable to influence an established tumor in the skin?

Autografts from spontaneous cancers established and growing in the skin, disappeared in 76 per cent of animals after tumors and surrounding tissue had been exposed to an erythema dose of roentgen ray, whereas other autografts of similar derivation which had received a like dose outside of the body, and had been implanted in the same animals, grew progressively in 96 per cent of instances. That this was not due to a greater susceptibility of the cancer cells, roentgen rayed in situ, was shown by the fact that tumors treated in situ with roentgen ray and then replanted in an unrayed location, on the same animal, grew actively. Evidently, the ray had done no direct damage to the cancer cells.

Pepper, G. E. Deep *x*-ray therapy, in gynecology. *Irish J. of Med. Sc.*, 5th Series, No. 14, April, 1923, 67–78.

Tube hardness is best found by a Benoist penetrometer, and no tube of less than 9 Benoist units should be used for deep therapy. The harder the tube, the more penetrating the ray and the less the effect on the skin.

The depth dose is measured by a water phantom, as water and the tissues have approximately the same absorbing power.

It is most important to allow between fields, at least 3 cm. to avoid overlapping doses on the skin.

Susceptibility to Irradiation. The skin of the neck and shoulders is the most sensitive, then the abdomen, upper legs and back. This difference does not exceed 10 to 15 per cent. Light haired people are about the same degree, more sensitive than black haired.

Patients suffering from nephritis or syphilis, may be 50 per cent more sensitive than those free from these diseases.

Leucopenia must be carefully watched for. The blood recovers its composition in three weeks after a sterilization dose, and six weeks after a carcinoma dose, and is used as an index of the results of treatment. Treatment must not be resumed until the blood has returned to normal.

The action is a short distance one, and varies greatly with distance, an intensity at 1 cm. being equal to 1; at 4 cm., it becomes .063 or only about 5 per cent of the initial energy. With roentgen-ray action, at a distance from 50 to 100 cm., it becomes possible to apply doses of fairly equal strength, on the surface and 5 cm. below it.

It is suggested that the roentgen ray acts by action on lecithin causing it to split and liberate cholin which poisons and kills the cells, the roentgen ray freeing the cholin in the cell itself. Malignant cells contain a higher percentage of lecithin than healthy cells.

Malignant cells have from 5.5 to 8 per cent of lecithin.

Testicles have 7.3 per cent lecithin.

Liver has 4.8 per cent lecithin.

Muscle has 2.3 per cent lecithin.

This may explain the so-called selective action.

Neuda, P., and Redlich, F. On the part played by the liver in generalized roentgen injuries. *Wien. klin. Wchnschr.*, 1923, xxxvi, 773.

Every roentgen radiation causes some change in the chlorin metabolism which consists in the transmission of chlorin into the blood from the tissues and from there through the kidney out of the body. If this course is pursued regularly, no severe symptoms will follow radiation. This metabolistic function, however, constitutes a slight roentgen injury. If the chlorin, however, does not pass into the urine, a lowering of the chlorin mirror in the blood is the consequence. This is seen in cases where the liver is either originally diseased, or where the hepatic function is insufficient. It may be seen in cases where the liver cannot meet the requirements of regulation following radiation. This is a relative insufficiency, which has been found increased where lack of salt exists. Severe roentgen injury will be the consequence.

The authors' experiments show that the roentgen rays have a definite effect on albumin, which is associated with the change in the chlorin metabolism of the body. In normal patients, especially in those with a healthy hepatic function, no disturbances arise. Superfluous chlorin is eliminated by the kidney. If the regulation does not take place a disturbance of the physico-chemical equilibrium occurs in the blood colloid from causes so far unknown. The leucocytes diminish, precipitately, and the blood pressure drops. The time for coagulation is changed, and the refractrometric index and a lowering of the chlorin mirror in the blood take place.

Perthes, J. On the biological and clinical effect of roentgen therapy in surgical cancer. *Strahlentherapie*, 1923, xv, 695.

There are a number of different conceptions of the effect of roentgen rays on cancerous tissue; (1) that they kill the cancer cells, acting much like a cautery or a corrosive, with the difference that the healthy surrounding tissue remains unaffected; (2) that the cacinoma cells are not killed, but their vitality lowered so that they may be overcome by the body resistance. These two theories accept a damage to the tumor cells by the roentgen rays. The adherents to these theories use doses which destroy, they cannot use lower doses than the carcinoma dose.

Two other theories accept an irritating or a stimulating affect which increases the defensive power of the organism. Stephan and Theilhaber speak of a local irritation which increases the defensive action of the surrounding tissues. The fourth theory reasons that a stimulation at a point distant from the tumor will mobilize vital forces in the body to overcome carcinoma growth. (Caspari, Opitz, Fraenkel.) The last author recommends radiation of the hypophysis.

It has, however, been found that the roentgen rays have a destructive influence on the entire organism as well as on the carcinoma cells. Radiation made after operation upon the mammary glands has been found to reduce the body resistance towards new growing carcinoma. Proofs of this were given by American and English investigators in animal experiment (Murphy, Nakahara, etc.). The immunity in rats and mice towards rat carcinoma decreased after roentgen application.

Cases of carcinoma which were healed were treated locally. It is evidently necessary that the cancer cell be damaged in order to derive a curative effect from roentgen rays. Specimens show that carcinoma cells are injured, and that their nuclei more especially degenerate under the influence of the rays. Evidently, they exert detrimental influence upon cell division.

Lacassagne found that twenty-four hours after the application of radium in uterine carcinoma only atypical karyokinesis was seen. In dog carcinoma roentgen rays produced atypical cell division within twenty-two hours. Four days later there was generalized extensive disturbance in the mechanism of cell division.

The best effects in circumscribed carcinoma are undoubtedly derived from giving large doses in one session.

If the roentgen rays cause a defensive action in the growth of the connective tissue, the course to pursue would be to give irritative doses. In that case the smaller doses would be more effective than the large ones, which destroy the cells. The repeated doses would be more effective than the large single dose. Caspari, Opitz, Kok, and Vorländer have made experiments which showed that surviving carcinoma cells in mouse tumor are not killed outside the body, and that their inoculability is not lost, even where large roentgen doses are used. Wood and Prime, however, found that mouse tumor cells were killed in vitro with four cutaneous erythema doses. The conclusion is reached that the effect of the roentgen rays must after all be considered as a damage done to the carcinoma cells, which are subsequently fully destroyed by the defensive forces of the body. Therefore, roentgen therapy must have the aim of damaging the tumor cells, and preserving the defensive forces of the organism. Not only the connective tissue around the cancer focus, but also the defensive bodies in the blood, and in the entire organism, must be preserved. Protracted intense radiation of large parts of the body damage the circulating blood. Often the bad effects of intense radiation after operation for mammary carcinoma will cause exhaustion of the patient. This is a sign of inadequate application.

Among 17 operable cases treated by the author, and who would not be operated, 15 were primarily healed; 3 showed recurrence; the total of cases which were not healed, was 5. The author estimates the probability of permanent cure as existing in less than 70.6 per cent.

Bier reports a case, on the other hand, where a woman, aged sixty-four, refused operation for a scirrhous mammary carcinoma, and who was cured by three series of six roentgen radiations. She remained well for six years, when she died of paralysis. Several other authors have reported on cures which lasted for several years. Berger and v. Seuffert found cases which remained cured for five years, and Berger had a lasting cure in 21.4 per cent. In one case of carcinoma of the tongue, in a woman, aged sixty-one, complete cure was effected. Radium and roentgen rays were used simultaneously and after four years no recurrence had been observed.

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SOME CONSIDERATIONS IN THE TREATMENT OF CARCINOMA OF THE ESOPHAGUS*

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A REVIEW of the more recent literature on carcinoma of the esophagus is apt to leave one with the impression that the physical agents have accomplished considerable in the relief of the disease. Unfortunately our results have not been so favorable, and for this reason we feel we should present an analysis of our experience to date.

Carcinoma of the esophagus has, up to the present, been fatal in practically 100 per cent of cases. There are obvious reasons for this. The histologic type of the growth indicates that it is extremely resistant to any form of treatment even in the most accessible locations. Situated in the esophagus, squamous carcinoma is still more formidable. Its inaccessibility and close approximation to vital organs make approach either very difficult or impossible. The esophagus is a thin-walled, flexible organ and a diagnosis of malignant disease is practically never made before the growth has extended beyond the esophageal wall. Dysphagia is almost invariably the initial symptom. This is due either to constriction of the lumen by the infiltrating annular type of growth or to occlusion by the bulky papillary type. This latter should be more amenable to treatment, but unfortunately it is less common and not usually recognized as such. A good deal of time is generally lost after this first symptom appears so that if the disease has not infiltrated widely at that period, it ordinarily has ample time to do so before the final diagnosis is reached. I am one of that minority who feels that the roentgen examination in these cases is not entirely conclusive, but a more liberal use of the barium plate as soon as difficulty in swallowing is noted would certainly turn attention in the right direction much earlier than is at present the case.

Another reason for the advanced stage of the disease before symptoms arise is suggested by Ewing. He calls attention to the anomalies of structure of the mucosa and to the canals which extend into the submucosa and even the muscular coat—the result of incomplete separation of the esophagus and trachea at an early embryonic period. It is possible and probable that the disease frequently originates in these canals and is well advanced before producing constriction or surface ulceration of the mucosa.

The various other symptoms of the disease—pain in the back or extending forward above the waist, cough, hemoptysis or vomiting of blood, recurrent laryngeal nerve pressure, supraclavicular or more distant lymph-node enlargement, are all evidences of a much wider infiltration or dissemination.

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The presence of dysphagia, with or without any of these later symptoms, should certainly call for immediate roentgen examination of the esophagus. The presence of the later symptoms, even without dysphagia, should, in the absence of a more obvious cause, indicate esophageal roentgen examination. If the roentgen examination suggests an obstruction, the next step should be a direct examination with the esophagoscope. This procedure can be readily carried out with a minimum of discomfort to the patient after proper cocainization of the throat, and furnishes valuable information. If the obstruction is due to carcinoma, it can readily be recognized in the gross, and a section taken to verify it. At times, but not always, a smaller instrument can be passed through the stricture to determine its lower limits and relations to the esophageal wall throughout. If the obstruction is due to pressure from without, valuable information can be obtained as to its probable origin. We have examined cases showing roentgen evidence of probable esophageal carcinoma which proved ultimately to be aneurysm of the aorta, partial calcification of the aortic arch, new growth of substernal thyroid, early mediastinal lymphosarcoma, or cardiospasm. We have also taken sections from growths at the lower end of the esophagus, quite frequently, which proved to be adenocarcinoma, thus indicating that the esophageal involvement was secondary to, and direct extension from a primary gastric carcinoma. This of course could have been settled, in most instances, by roentgen examination of the stomach as well as the esophagus, but I do not believe it is done as a routine in many clinics. It should always be done where the involvement is at the lower end of the esophagus.

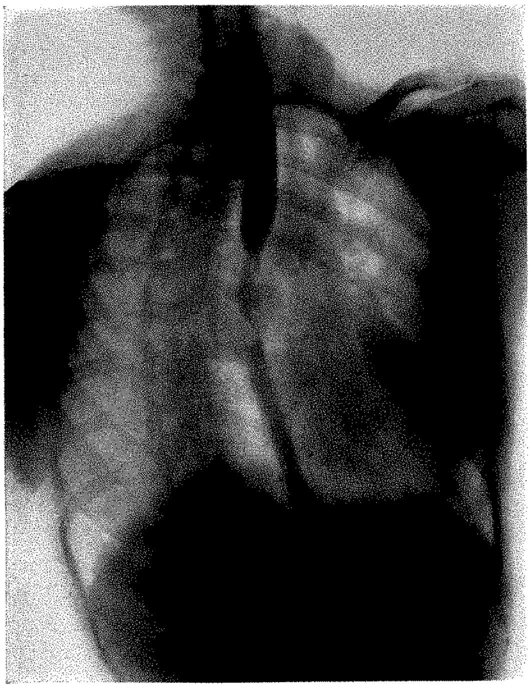
FIG. 1. Typical carcinoma of esophagus. Roentgen-ray examination furnishes practically all necessary information here.

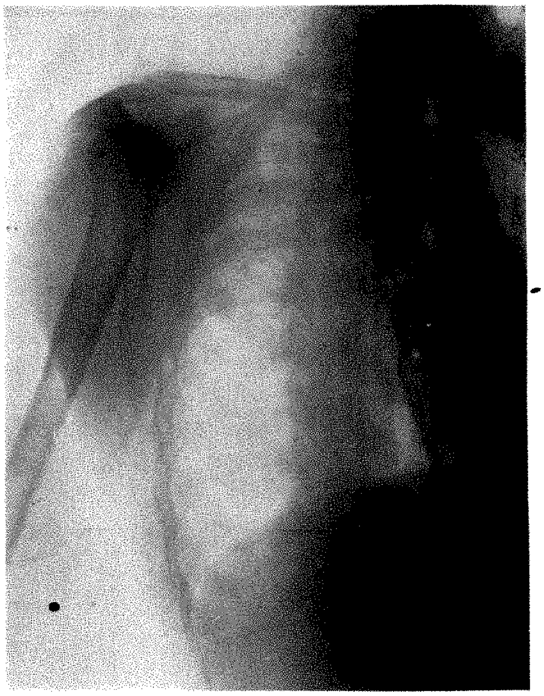
FIG. 2. Carcinoma of esophagus. Length of esophageal wall involvement not determined by roentgenogram.

I have digressed in the field of diagnosis to emphasize the importance of early roentgen examination in all cases of dysphagia and the value of the esophagoscope in both direct and differential diagnosis.

Having established the diagnosis, the question of treatment arises. This is one of the most difficult in the entire field of malignant diseases. Our problem is that of a resistant adult type of carcinoma, nearly always in an advanced stage, inaccessible and closely related to vital organs, with a history of practically 100 per cent mortality. We must always consider treatment as palliative. This means adherence to those methods or combination of methods which give most relief with least risk and discomfort to the patient.

Before the advent of radiation therapy, the only worth-while relief was that obtained by a gastrostomy, and in many instances this relief was questionable. The various types of gastrostomy were all more or less objectionable and were usually postponed until too late to be of much service to the patient. Radiation has, in general, tended only to withhold this measure of relief until too late in a large number of cases. Many attempts were made to remove the growth surgically. All failed until Dr. Franz Torek in 1913 reported the first successful attempt at resection of the thoracic portion of the esophagus. This patient is still alive. While this was a wonderful piece of surgery, it is questionable if the single success justified the many unsuccessful attempts which were subsequently stimulated by it. The recent rapid advances in thoracic surgery are, to my mind, suggestive of very real possibilities. Not that I believe we can anticipate cure of esophageal carcinoma by surgical removal. After eliminating all of the physical factors and operative risk, the operative field is too limited, and besides, the reasonable hope for cancer cure does not lie in this direction. Dr. Lilienthal has recently shown that an esophageal carcinoma can be safely and accurately exposed surgically. While his patient unfortunately died following treatment of a recurrence after resection, it nevertheless marks a great advance and suggests the possibility of combining surgical exposure and interstitial radiation, without removal. This method has, in other parts of the body, shown some brilliant results, and it is only reasonable to believe that, in certain cases at least, it may be extended to the esophagus.

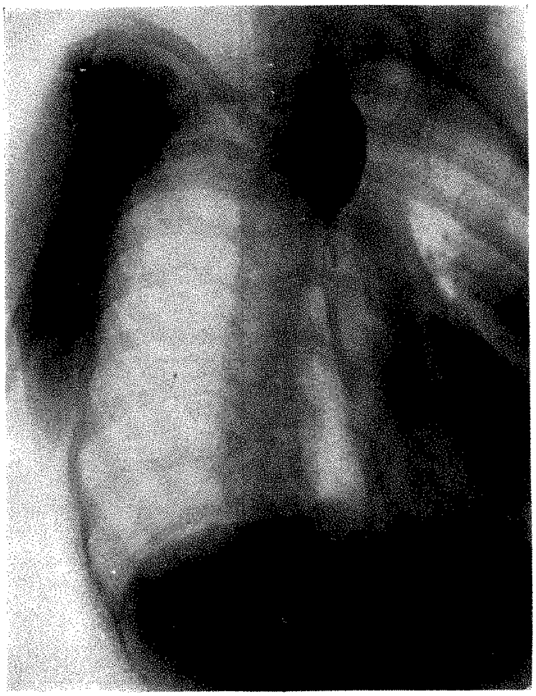

FIG. 3. Questionable stricture. Direct esophagoscopy necessary to confirm diagnosis.

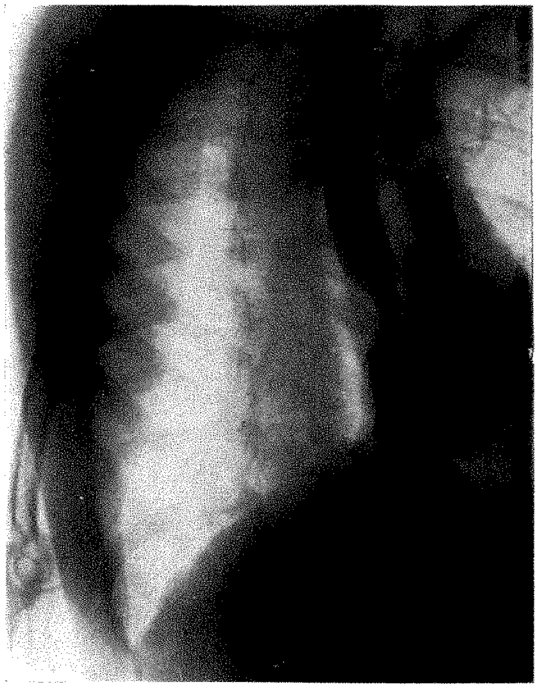

FIG. 4. Questionable filling defect. Direct esophagoscopy necessary to settle diagnosis.

During the past seven years we have treated at the Memorial Hospital 196 cases of esophageal carcinoma. In the beginning we were hopeful that in radium we had at least an agent which would control the disease.

Our first cases were treated during the period when radium dosage and filtration were purely empiric and experimental. Small doses seemed to control the surface ulceration, but the growth continued to extend at the periphery. Several times we felt that we were making real progress, only to find at a later date evidence of the outward extension of the disease. In other words, we were treating a canal through the central part of the tumor but exerting no appreciable influence on the bulk of it. I believe this method of small doses at intervals served about the same purpose as the periodic dilatation with bougies as practiced in some clinics. It had the added advantage of controlling surface ulceration and bleeding, to a certain extent. Our method of placing the radium within the stricture is not unlike many other plans described in the literature. We use tubes arranged end to end in rubber tubing supported by a wire, and enough tubes to cover the involved area throughout. This applicator has an enlargement on either end to prevent slipping upward or downward. We always introduce it directly through the esophagoscope for the reason that accurate approximation can always be best made by direct vision.

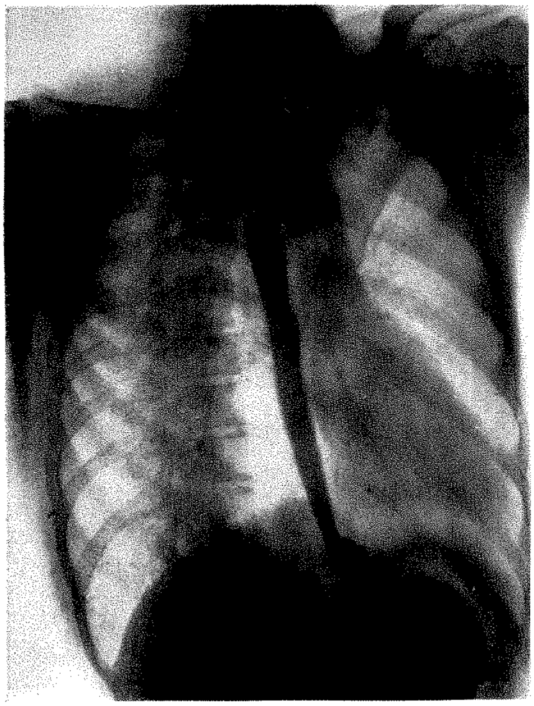

Fig. 5. Stricture of lower end of esophagus. Direct examination and biopsy necessary to determine whether growth arises in stomach or esophagus.

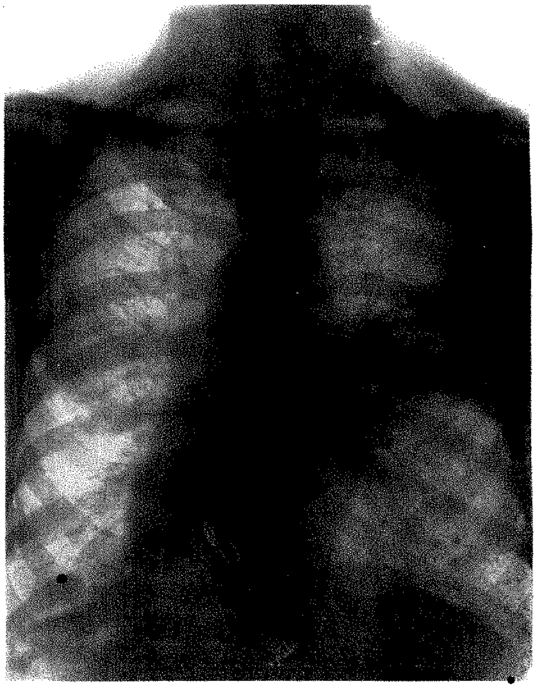

Fig. 6. Carcinoma of mid-thoracic esophagus extensively infiltrating portions of lungs.

As soon as we attempted to control the disease by heavier intra-esophageal applications, various unfavorable symptoms arose. Evidences of a severe local reaction with consequent swelling of surrounding tissues and, at times, sloughing, were noted. This only tended to increase rather than relieve the obstruction. We also felt that the sloughing was particularly dangerous in the esophagus. It increased the factor of hemorrhage, and perforations into the bronchus or mediastinum were more frequent.

We next turned our attention to external radiation both alone and in conjunction with intra-esophageal applications. Low voltage roentgen rays did not seem to be worth while. The use of the radium pack in full doses at distances of 10 cm. and 15 cm. appeared to slow up the rate of growth and to relieve pain in certain instances. This procedure, however, was impracticable on account of the large amounts of radium required for a single case. High voltage roentgen rays have replaced this use of the pack very successfully and give results uniformly better because of the more practical economic considerations.

Throughout this period up to the high voltage roentgen ray stage, gastrostomy was employed as a last resort. In a few cases it proved beneficial, but as a rule the patient's resistance was so lowered that rebound was impossible. Our next step was to urge a gastrostomy earlier wherever the obstruction was at all marked. This was a distinct improvement and added very appreciably to the patient's comfort and length of life. We have been so impressed by the benefits of an early gastrostomy that we now urge and insist upon it in all cases at the outset, even though the obstruction be slight. The benefit is not only in the facility provided for adequate feeding, but, as Dr. Chevalier Jackson has noted, the swallowing improves after a period of rest to the esophagus. There is no question that the mechanical irritation of constant and forced efforts at swallowing increase the rate of growth, as well as the incidence of local mixed infection.

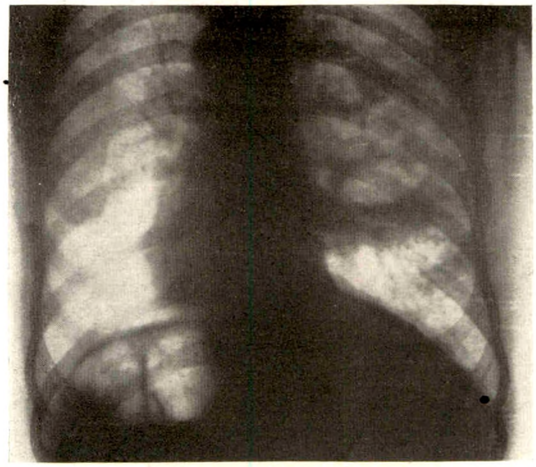

Fig. 7. Carcinoma of esophagus, ruptured, and terminating in lung abscess.

The operation should always be done at the time when the patient looks upon it as quite unnecessary. The surgical shock at this period is negligible. Most of the objections to a gastrostomy are eliminated by the technique originally described by the late Dr. H. H. Janeway. This method does away with the necessity for a continuous rubber tube, by constructing from a portion of the anterior stomach wall a tube lined by gastric mucosa. This "goose neck" is delivered through a small opening below the lower left costal border in a manner which permits of a sphincter action by the upper abdominal muscles, and leakage of food is a negligible factor. The procedure is a simple one, easily done under local anesthesia, through a short midline incision and the patient can be gotten out of bed in three or four days. The period of confinement in bed is particularly important in the more advanced cases.

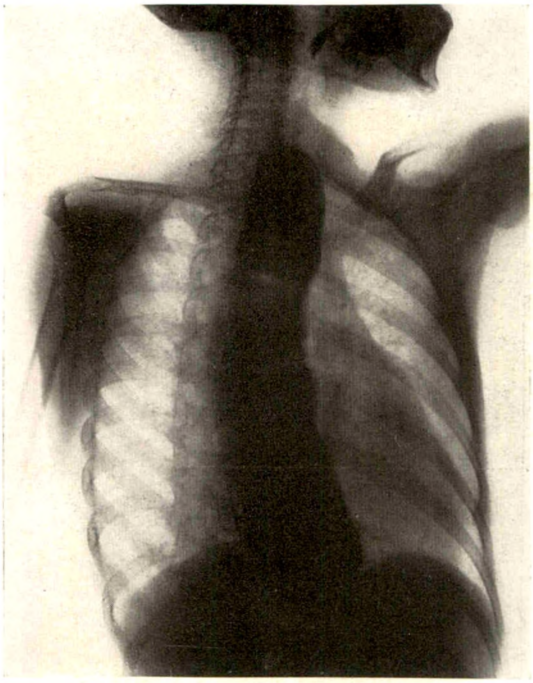

Fig. 8. Typical case of cardiospasm.

This plan of combining early gastrostomy with radiation, chiefly high voltage roentgen rays, has given by far the best results in our experience.

In our series of 196 cases, we have performed gastrostomies in 106. Unfortunately many of these were done too late to be of real value. A detailed report of the entire series of cases is of no value because it is only in the more recent ones that we feel that we have developed a procedure giving a worth while chance for palliative relief. The length of life under treatment in most of the cases was short. The oldest case is now alive and enjoying reasonable comfort four years and four months after gastrostomy plus a moderate amount of radiation. Another case lived four years and three months under radiation alone and died ultimately of extension of the disease to both lungs.

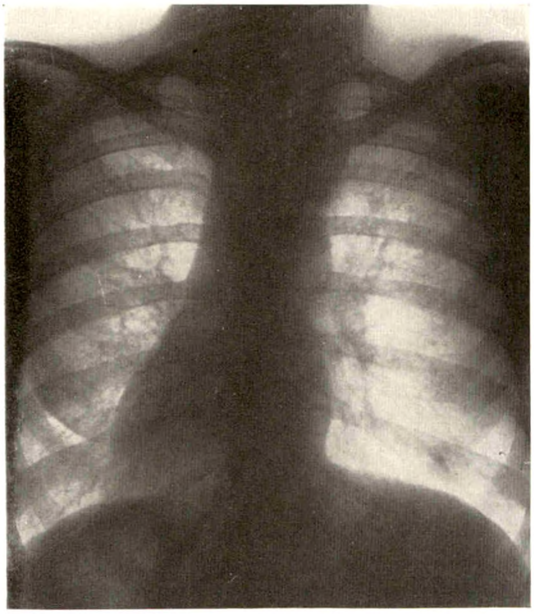

Fig. 9. Mediastinal lymphosarcoma producing symptoms very suggestive of esophageal carcinoma.

We hope that the earlier gastrostomy plus more intensive high voltage roentgen rays will in future give a longer period of palliative relief.

CONCLUSIONS

1. Carcinoma of the esophagus is a disease in which we can hope for palliative relief only.
2. An early gastrostomy offers the major portion of this relief.
3. External radiation, preferably with high voltage roentgen rays, aids in slowing up the rate of tumor growth, but so far has not controlled it.
4. Intra-esophageal application of radium, preferably in small repeated doses, is indicated to control ulceration and bleeding locally but has little influence on the actual progress of the disease.

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DISCUSSION

Dr. Herendeen, Memorial Hospital, New York City. It seems that if anything is to be accomplished in the treatment of these cases, the main reliance must be placed upon external radiation, gastrostomy being used only as an adjunct to the main treatment in order that the patient's nutrition may be maintained. It seems clear that the preferable form of radiation should be the high voltage method. We, as a rule, before attempting to treat these patients, roentgenoscope them with a fairly thick barium meal and mark off on the chest wall the level of the growth. Then we use, as a rule, exposures varying from 60 to 80 min. with a target skin distance of 50 cm., 4 ma., 200 kv., ½ mm. Cu. These treatments vary from three to six in number, and are given as a rule at two or three day intervals; on some occasions we have given them daily. I think that it may be wise to offer a word of caution about attempting to give the entire series in less than a week's time, and perhaps that is often too much, because of the danger of ulceration and breaking down of the tumor, subsequent leakage, perforation into a bronchus and a fatal termination as a result. Only recently have we seen a ray of hope from this method of treatment, and that largely because we have been able to maintain the nutrition of the patient or build up the patient somewhat as a result of the gastrostomy, before attempting any treatment.

Dr. Pancoast, Philadelphia. I rise to discuss this paper for two reasons, first, because I appreciate the excellent technique which has been employed by Dr. Quick in the treatment of his cases, and second, because of the stimulus recently given to me by Dr. Jackson in an effort to try to do something for a condition which has heretofore been absolutely hopeless as far as curing it is concerned. I would like to go back to the very beginning of the condition and say a word about the diagnosis. Esophageal carcinoma cannot always be diagnosed by the barium meal alone. This fact has been brought to my mind on several occasions. I had a cook in my family in whom I missed the diagnosis by the barium meal, and it was seven months before a diagnosis was made in this manner. I had her under observation practically every day in that interval. On another occasion we followed the technique we have employed more recently. Wherever we have evidence of dysphagia or, more important than that, substernal pain, because substernal pain may precede dysphagia, we always have the patient swallow a capsule, and it has never happened that there has not been something wrong in the esophagus when the capsule was obstructed. Recently we detected a carcinoma a month before it could be detected by the barium meal, and in another case a week before. The next procedure is the esophagoscope in good hands, first, to confirm the diagnosis; second, to tell the nature of the growth; and third, the extent of the growth and the size of the structure. The next procedure is a gastrostomy, before any method of treatment is employed. Dr. Jackson is firmly convinced that it is absolutely essential for many reasons.

The feeding of the patient should not be left to us, nor should it be left to the surgeon. We have found that a medical man who thoroughly understands feeding in this manner is the only one competent to take charge of the patient. He knows exactly what the man will need in the way of calories to build him up. We have attempted to have the surgeon feed the patient through the tube, and found the patient continued to go down hill, whereas if the medical man was called in the patient began to gain weight because he got the food to build him up. The patient is in better condition to have the gastrostomy made in the beginning; the mortality is much higher in the late cases than in the early ones, so we need not consider the mortality of gastrostomy cases if handled at the proper time. An additional advantage of gastrostomy is that it enables us to measure the exact extent of the growth, because Dr. Jackson and Dr. Tucker not only examine the patient from the mouth down, to get the upper limits of it, but as soon as the gastrostomy will permit, they examine the patient by a retrogastroscopy to determine the lower limits of the growth. We have been much surprised to find that it often extends throughout the entire extent of the esophagus, from the upper constriction down to the stomach; in fact you may find multiple lesions that need treatment. The first case called to our attention was reported by Dr. Smiles, in which a carcinoma of the upper part of the esophagus was treated over a period of two or three years, and then later on they found a lesion at the lower end of the esophagus, probably metastatic from the upper lesion. It is absolutely necessary to get the entire extent of the lesion before you put in your radium applicator, and also to get the number of lesions which may be present. We have been surprised in some instances by following this technique to find exactly what Dr. Quick shows, that we were not dealing with an esophageal carcinoma at all, but with an upward extension from a carcinoma of the stomach. The biopsy may bring this to our mind by showing a different type of carcinoma from that usually found in the esophagus.

Dr. Manges, Philadelphia. I would like to say a word about the method of examining these esophagus cases. You will recall that sometime ago I advocated the prone position for demonstrating lesions of the esophagus. It is true that a lesion of the esophagus that narrows the lumen sufficiently to retain a capsule, will show that there is a narrowing at that point; but it tells nothing about the condition of the esophagus below that. If you have the patient in the upright posture and the stricture is fairly narrow, the barium trickles through slowly and immediately goes in a narrow stream into the stomach, and you get no idea of the condition of the esophagus below the level of the stricture; neither would you with the capsule, but if you have the patient in the right oblique prone posture and the lower end of the esophagus turned up a little to the left, it becomes the highest point. The patient then drinking through a rubber tube, fills the upper portion and by means of the swallowing effect plus the peristalsis of the esophagus, forces the barium mixture past the stricture or through the stricture area and it stays in the lower portion of the esophagus long enough for you to get an idea as to its lumen. I first got this from a study of the foreign body cases and especially the constricted esophagus following the drinking of some irritating substance such as lye. There may be strictures in these cases at different levels, and where you have the stimulus of operation to cure the patient, you are apt to go to much greater lengths to study it, knowing that they can dilate those strictures. It was a stimulation to me to go ahead and find out what the condition of the entire esophagus was, and we have on more than one occasion demonstrated very definite constrictions at widely separated points, so that if you will examine those cases of carcinoma of the esophagus and especially those below the level of the suprasternal notch in the right oblique prone posture, you will get along without the necessity of using capsules and get a very definite idea as to the extent of the growth.

Dr. Holmes, Boston. I would like to say a word first in regard to the diagnosis. Our trouble has not been in differentiating these lesions of the esophagus from tumors outside or from cardiospasm, but it has been in missing the very early cases. I think that is where the direct esophageal examination is going to be of the greatest aid to us, before any true stricture has taken place and while roentgenologic evidence is still absent. In most of the cardiospasms, a drink of some hot liquid may relax the cardiospasm. I have seen that happen a number of times; there is a good reason why it should tend to relax under heat. Then there is the question of lung metastases in these cases. The case Dr. Quick showed no doubt was metastasis, but I have seen very similar cases due to inhalation of ammonia. These cases have difficulty in swallowing, so we must not be discouraged entirely if we find something in the lung that looks like a metastasis. Then on the question of treatment, we have been through practically the same thing Dr. Quick has described and arrived at practically the same conclusions. There was one thing in the treatment of cancer of the esophagus which should urge us to try hard for a cure by radiation, and that is, it is a tumor that does not metastasize early; and secondly, it is practically never cured by surgery; so that here we have a tumor which ought to be discovered fairly early, though it is not, and which does not metastasize early and is no more resistant to radiation than some forms of skin cancer which are cured by radiation. We have not resorted to gastrostomy as early as the gentlemen here have advised, and I think we are justified in some cases. We have a case under treatment now of a patient who was able to eat any sort of food, who, when he came to the clinic, was unable to swallow anything except liquid; I wonder if a case such as that with the cauliflower-like growth out into the esophagus which could be reduced with a small amount of radium seeds and cross-fire radiation, might not be handled without a gastrostomy, and if cases of lymphoma pressing on the esophagus, which would respond readily to roentgen treatment could be handled without gastrotomy. Certainly a patient when he first has a gastrotomy done, has more difficulty in handling his food and keeping up nutrition than if he can eat in a normal manner.

Dr. Quick. In reference to using the bare tubes directly in the growth, I think it is a hazardous procedure. We tried it, but with disastrous results. The esophagus is a thin-walled organ, surrounded by many important structures, and I think the danger considerable. Even if we were to get what ultimately would be a satisfactory regression of the local area, there would be enough swelling incident to the radiation to interfere seriously with nutrition.

I should have liked to mention several things relative to diagnosis, but I felt that that did not come quite within the scope of the paper. I am grateful to the gentlemen for discussing that side of it. There are two points which I wanted to make: first the use of the esophagoscope in diagnosis; second, early gastrostomy to provide for the nutrition of the patient while we were doing what we could by way of palliative radiation.

Dr. Dunham, Cincinnati, O. I would like very much to know if there have been any cures in any of those cases? Has anybody had a case get well?

Dr. Quick. The only cure that I know of is the surgical case reported by Dr. Franz

Torek, and just before coming down the other day I called him up. He said the patient was still alive. I think we all get spasms of enthusiasm once in a while. One case I referred to we had watched carefully at intervals, making regular examinations by the direct method up to nearly four years, the lesion was healing, it looked very well; then the patient came in coughing a little one day, which answered the whole question—we had very successfully treated a hole through the growth all this while; meanwhile it was extending little by little; the roentgen findings at that time were verified by an autopsy four months later.

THE DIAGNOSIS OF PRIMARY INTRATHORACIC NEOPLASMS*

BY GEO. F. THOMAS, M.D., AND H. L. FARMER, M.D.

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THE diagnosis of primary intrathoracic neoplasm is a problem of peculiar interest to the roentgenologist. In the vast majority of cases, the lesion is elusive to the ordinary methods of physical examination and often no suspicion of its presence is entertained until evidence of some unusual condition is disclosed by the roentgenogram. The lesion is not rare but is infrequent enough to test one's diagnostic alertness. The roentgenograms present features which occasionally are almost pathognomonic, but more frequently challenge the keenness of observation and deductive faculties of the roentgenologist. Furthermore, the possibility that intensive treatment with short wave-length radiation in the malignant cases may prove of more than temporary benefit, places on us a very definite responsibility to do our utmost toward the early detection of these lesions, so that if the lesion is malignant, treatment can be started at the earliest possible moment when the area of involvement is limited and before metastasis has taken place. On the other hand, if the lesion is benign, an unfavorable prognosis should be avoided and the patient not subjected to radical treatment, either by surgery or the roentgen ray, (which, when applied to the lungs especially, cannot be regarded as other than a radical procedure). The roentgenologist who gives such a treatment must bear his share of the responsibility in so far as the roentgen ray can be of value in the differential diagnosis.

This paper will be devoted chiefly to a presentation of 6 consecutive cases of primary malignant tumors of the lung correctly diagnosed before death and proven by autopsy, on which the authors have collaborated in the Cleveland City Hospital during the past eighteen months. The diagnosis in 1 case was primary chondrosarcoma of the lung. The remainder are cases of primary bronchial or lung carcinoma, and our discussion will be primarily of this type of tumor. In 2 of the cases, the roentgenograms furnished the data upon which the diagnoses were based.

To emphasize the need of routine roentgen-ray examinations of the chest, we are reporting, in addition to these 6 cases, 2 others (from the records of Drs. Hill and Thomas) in which the physical signs were negative at the time the diagnoses were made from the roentgenograms. One was an endothelioma, probably of mediastinal origin, which in some respects resembled a primary lung tumor. The other was a benign tumor, which had been diagnosed as a xanthoma. It is of special interest because primary benign tumors are extremely rare and the coincidence of roentgenographic and pathological findings even more infrequent.

A survey of the literature would not lead the casual reader to place much dependence on roentgenography as an aid in the diagnosis of lung tumors. A careful analysis, however, of those articles which report in detail the clinical data, pathological reports and especially the roentgenographic findings of proven cases of primary intrathoracic neoplasm, shows so definitely the value of roentgenography in this connec

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tion that we cannot ignore statements, which have been passed down as a sort of legacy by succeeding authors, to the effect that "in the diagnosis of lung tumors, the roentgenograms have been either of negative value or at times even misleading."

To pass by such statements without criticism would be the grossest neglect, in view of our firm conviction that whatever improvement has been made in the diagnosis of diseases of the lung in the past twenty-five years or more is due in most part to the science of roentgenology. We know, and it is the primary object of this paper to show, that failure to resort early and routinely to careful roentgen-ray examination of the chest will result in the failure to detect and diagnose a large percentage of intrathoracic neoplasms.

Without special search, one of us has found (in the files of Drs. Hill and Thomas) records of a dozen cases of malignancy of the lungs, several of them primary, diagnosed directly because of the roentgen-ray findings and subsequently proven by autopsy or biopsy or adequately verified by the subsequent clinical history. We cannot recall one case where a lung tumor was found at autopsy in a patient whose roentgenogram was negative. We have found only two such cases reported in the literature.

Fishberg and Steinbach claim accurate diagnoses in 32 out of 33 cases of cancer of the lung and say it is their conviction that the cases were diagnosed during the life of the patient, because they "relied mainly on purely clinical methods, on the history, symptomatology, course and physical signs, while other diagnostic and laboratory methods such as cytology of excretions and exudates and radiography were invariably considered of merely confirmatory importance." This implies that practically all cases of lung tumor can be diagnosed without the aid of the roentgenogram. We admit that the percentage of diagnostic accuracy could not have been much higher, even if their list of diagnostic procedures of merely confirmatory importance had included the autopsy itself. But our experience and a review of the literature convinces us that roentgenography must have directly or indirectly played a greater rôle in these diagnoses than the authors realize. With its aid, and with proper cooperation between clinician and roentgenologist in the interpretation of data obtained from the "history, symptomatology, course, physical signs," laboratory findings and especially the roentgenograms, we agree that most cases of cancer of the lung can and should be correctly diagnosed. Without it, even with the increased accuracy in the interpretation of physical signs that has resulted from the use of the roentgen ray, many cases, not only of lung tumor, but of all kinds of lung disease, will be incorrectly diagnosed. A comparison of physical diagnoses with the autopsy findings in any large clinic proves this. In some cases, especially in early cases of lung tumor, the physical signs are negative. In others, the only physical signs are those of the complications, most frequently pleural effusion. In the absence of any further data, the examination would end there, and the correct diagnosis of the primary lesion, the lung tumor, would not be made.

The rarity of such diagnoses before the advent of the roentgen ray indicates the truth of the above statements. The comparative frequency since cannot be accounted for by any slight increase in the incidence of the disease, nor do we believe it can be entirely explained by any improvement in the art of physical examination or correlation of the physical findings with the symptoms and clinical history.

Most authors have agreed that lung tumors are rarely diagnosed clinically. In a series of 90 cases of bronchial carcinoma collected by Weller in 1913, only 10 were correctly diagnosed. Barron in 1922 reported a series of 13 cases, but only 3 out of the 13 were finally given correct clinical diagnoses. Many other articles might be analyzed and quoted, but these few are sufficient to show that even at the present time, for one reason or another, most cases of lung tumor are not recognized until post mortem.

This, at first glance, would appear to be a sad commentary on our methods of diagnosis, in view of the fact that most cases of lung tumor present symptoms referable to the chest, and especially in view of the fact that physical conditions could hardly be more ideal than in the thorax for purposes of physical examination and roentgenography. We are convinced, however, that the fault lies, not so much in the inadequacy of available diagnostic methods as in a failure to use them and to properly evaluate the data obtained when all the methods are used. In Barron's 13 cases, for example, apparently only 6 were roentgenographed. The roentgen-ray findings as reported were almost diagnostic in 4 and were very suggestive in the other 2, but only 3 of the entire 13 cases were finally given correct clinical diagnoses. It is evident that too little reliance was placed upon the roentgenograms. An analysis of the autopsy findings in the 7 cases not roentgenographed indicates that roentgenograms should have been helpful in all, and might have been pathognomonic in some. In none could they have been negative.

Next in importance to making a roentgenographic study of the chest as much a part of the routine examination of every patient as the usual physical examination, is the method of utilizing the data thus obtained. The roentgenogram records variations in density according to fixed physical laws. It may be assumed that every abnormal shadow means a corresponding abnormality in the patient, and conversely that every gross pathological variation in density should produce a corresponding variation of shadow on the roentgenogram. This does not mean that the outline of a lung tumor can be distinguished through a pleural effusion or that one can differentiate the shadow of a tumor from the surrounding lung that is drowned in an exudate consequent to the occlusion of a bronchus. Some lung tumors may be too small or may not produce enough variation in lung density to be detectable on the roentgenogram. In one rare instance a small tumor in the upper right bronchus disappeared into the shadow of the spine when the upper lobe collapsed. But these obvious limitations do not alter the fact that the roentgenogram is essentially accurate; in fact, outside of actual section, the most accurate method we have of detecting any gross pathological change in the lungs. As such, it should serve as a basis for further investigation rather than being used as a means of confirming or disproving a diagnosis arrived at by less accurate methods. This practice is in no small part to blame for the unfavorable appraisal of the roentgenogram entertained by many internists. A hasty glance at an "x-ray picture" will often "confirm" an incorrect physical diagnosis. A careful study of roentgenray shadows should never prove misleading. We have often found that the presence of shadows that gave the clue to the correct diagnosis, was not detected or considered of any significance by those who had already formed a diagnostic opinion from other methods.

A knowledge of the gross pathological characteristics of primary lung carcinoma is fundamental, not only in the interpretation of the physical and roentgen findings but also in the synthesis of the information derived from these two methods. The following brief summary of them given by Moise serves unusually well to bring out the features of interest in the interpretation of roentgenograms. "The gross anatomic appearance of lung tumors is very variable and there are no well-defined gross types. A nodular form, an infiltrating form, and a miliary carcinosis have been described, and these descriptive terms are frequently used in classification, although they are obviously applicable rather to stages in the growth of a tumor than to distinct types of tumor. The nodular form includes rare cases of a single nodule or a few small nodules in the pulmonary parenchyma, or localized papillary tumors arising in the walls of tuberculous or bronchiectatic cavities and are only discovered incidentally at necropsy. The infiltrating form is the usual finding, as the majority of cases are seen in an advanced stage when there is extensive invasion or infiltration of the lung. In these tumors the most significant gross finding is that the tumor is confined to, or is much more extensive in one lung, while secondary tumors are frequently distributed widely throughout both lungs. In advanced stages of the primary tumors, the distribution of the cancerous invasion within the lung is quite uniform, the bronchi and blood vessels are encircled by bands of tumor, which becomes more and more conspicuous as the hilum is approached. These peribronchial tumor masses may compress the larger bronchi with resulting total or partial occlusion leading to atelectasis and bronchiectasis. A large mass of carcinomatous tracheobronchial lymph nodes is frequently found filling the angle between the main bronchi. The hilic nodes on the opposite side are not infrequently involved, but the opposite lung itself is relatively free from tumor nodules. The cases described as miliary carcinosis are said to resemble miliary tuberculosis, except that the nodules are somewhat larger, more translucent and whiter in color, and are situated only along the course of the lymphatic channels. This finding is apparently indicative of an early widespread lymphatic invasion of the lung."

Most pathologists have considered that there are three types of carcinoma of the lung, one arising from the lining epithelium of the bronchus, another from the mucous glands and the third from the alveolar epithelium. Recently the last class has been considered very rare, some question its occurrence at all. Accurate conclusions regarding the point of origin may be impossible because different sections of the same tumor may show characteristics of all three types. It is generally agreed that most are of bronchial origin, usually from the main branches, although some apparently originate from the smaller bronchioles.

Ewing indicates that a bronchial carcinoma that arises from the lining epithelium is rarely a large diffuse tumor of the lung; it usually arises at or below the bifurcation of the trachea and extends along the walls of the bronchi; the bronchi may be occluded with papillary projections resulting in bronchiectasis; these tumors are apt to break down with the development of cavities filled with mucopurulent material; they may extend into the mediastinum, the pleura and the chest wall; pleural effusions in this type are frequent. He further states that carcinomas arising from the mucous glands are limited chiefly to the walls of the bronchi; that they arise from the same region as the former type; there may be considerable infiltration of the parenchyma; that as a rule the bronchial lining is intact, but may collapse into folds, the characteristic tendency being to stenosis of the bronchi rather than dilatation. In this type, on account of the compression of the bronchi, we have sclerosis and atelectasis and contraction of the lung. The pleura may become thickened and there is usually invasion of the hilar lymph nodes. The diffuse type may resemble pathologically an atypical, acute pneumonic process. Cavities may develop in areas of necrosis. The pleura is usually involved. Local and general metastases are frequent.

The arteries, veins, air passages and lymphatic channels are the obvious routes of extension and metastasis. The lymphatic distribution is of especial interest in explanation of the occasional triangular shaped areas of involvement in the parenchyma, and the limitation of the area of density to the interlobar line, so frequently sharply outlined in upper lobe tumors.

There are two sets of lymphatic channels, one following the branchings of the bronchial tree, the other distributed through the pulmonary pleura. Normally, both the pleural and the pulmonary channels drain in opposite directions from the surface of the lung toward the hilar lymph nodes. The only peripheral anastomoses between these two sets are the lymphatic channels in the interlobular septa. These channels contain valves which prevent the flow of lymph from the pleura to the deep lymphatics of the lung, but allow drainage from the lung to the pleura if the normal drainage along the bronchial tree is obstructed. The lymphatics accompanying the bronchial tree anastomose freely, especially about the points of division of the bronchi and bronchioles.

Metastases occur in a large proportion of cases, the more important sites in order of frequency being the regional lymph nodes, liver, pleura, kidney, lungs, brain and bones.

In Hodgkin's disease, lymphosarcoma and other tumors arising from the mediastinal or hilar nodes, we occasionally find infiltration of the surrounding lung tissue, which may simulate the appearance of a bronchial carcinoma. With the exception of lymphosarcomata involving the mediastinum, primary sarcomata in the chest are extremely rare.

Benign intrathoracic tumors are even more infrequent.

Most cases of pulmonary cancer present symptoms referable to the chest, though in a few cases recorded, the only symptoms were those resulting from metastases, frequently in the brain. In a couple of cases reported, a fatal hemoptysis was the only symptom. Cough and dyspnea occur in almost every case. The cough may be dry or may be accompanied by expectoration. Blood tinged, or raspberry jelly-like sputum is very suggestive. Pain occurs in the majority. It may be referred to the shoulder or arm on the affected side and occasionally to the abdomen. It is rather characteristic in its early occurrence, its gradual onset, and its persistence, and it is not relieved by the presence of a pleural effusion. It may at first be only a feeling of oppression. Dyspnea occurs in practically every case. It is usually progressive.

Weakness is often noted early and appears to be out of proportion to other physical signs. Loss of weight is usually progressive, but may not be marked until the final stage. As in malignancy elsewhere, the patient may have periods during which the weight increases. Fever may be present because of the frequent inflammatory complications.

When any patient past middle life gives a history of progressive dyspnea or persistent pain in the region of the chest, the possibility of lung tumor should be considered, especially in the absence of cardiovascular disease, and the patient should be submitted to careful physical and roentgen-ray examinations. For the purpose of elimination, the roentgen ray is of prime importance inasmuch as it would be very rare to have negative roentgen findings in any case in which the tumor had progressed far enough to cause symptoms. The physical examination may show changes in auscultatory sounds, but would probably be negative from the standpoint of percussion, until later stages. A layer of unimpaired lung a few centimeters thick is usually sufficient to disguise the presence of a tumor to palpatory or indirect percussion.

The physical signs vary according to the size and location of the growth and the amount of involvement of the air passages with the accompanying secondary changes. The interpretation of the physical signs is facilitated by the knowledge of the presence, the location and the extent of the involvement as shown by the roentgen-ray examination. Percussion may vary from normal over small tumors to flatness over airless lung or dullness or flatness over those that have extended to the chest wall. If the tumor is central, whatever change there is in the percussion note will be due to change in the air content of the overlying lung. Sometimes the variation in the note from that obtained over the surrounding uninvolved region is not enough to be detectable. Tumors several centimeters in diameter are occasionally discovered by routine roentgen-ray examination in cases where such a lesion cannot be suspected from the physical signs elicited either before or after the presence of the tumor has been demonstrated.

The breath sounds may be diminished or absent. A partial occlusion of a bronchus may give rise to a peculiar amphoric breath sound called cornage, which sign is very suggestive of bronchial carcinoma.

About 50 per cent of cases have pleural effusion with associated signs of absence of breath sounds and flat percussion note, that is, the same as might be caused by the tumor itself.

Enlargement of the supraclavicular or axillary lymph glands is suspicious especially in conjunction with evidence of disease in the chest. Nodules may be found on the sternum or ribs. Sections of these glands or nodules may decide the diagnosis.

Hemorrhagic effusion should at once suggest the possibility of malignancy. Occasionally cells may be present in the aspirated fluid or in fragments of the tumor caught in the needle which will disclose the identity of the growth. In one of the cases we are reporting, Dr. Howard Karsner was able thus to determine the type of tumor.

Edema of the face and neck, or distention of the superficial veins of the chest may result from involvement of the mediastinum, because of pressure on the venae cavae.

The problem of differential diagnosis may be diagrammed as follows:

- Inflammatory processes vs. Neoplasms
  - Benign
    - 1. Mediastinal
    - 2. Pulmonary
    - 3. Pleural
  - v.s.
  - Malignant
    - Primary
      - 1. Mediastinal
      - 2. Pulmonary
      - 3. Pleural
    - vs.
    - Secondary
      - Ditto

The differential diagnosis indicated on this diagram can be made in almost every case. The roentgen shadows may be as varied as all the pathological combinations can make them, but most cases of primary lung tumor present pictures that are quite unlike the more usual inflammatory processes with which they are so often confused clinically. The most frequent incorrect clinical diagnosis is pulmonary tuberculosis. This error would occur in the interpretation of the roentgenograms only in those cases where a miliary carcinosis might be confused with miliary tuberculosis, or massive lobar cancer with caseous pneumonia. The respective rarity of primary miliary carcinosis and massive lobar tuberculosis would make these errors uncommon. In such cases, or in any other, where the roentgenogram simulates, an infectious process, one would hardly expect a coincident similarity in the physical signs and clinical history. The differentiation between benign and malignant neoplasms may sometimes be indicated by the clinical progress, and a study of the method of growth, by repeated roentgen examinations of the periphery of the tumor from different angles. The law of probabilities favors malignancy. Rapid growth, an indistinct border, radiating projections from the tumor mass, multiple nodules, evidence of metastases to ribs or vertebrae and pleural effusion would indicate a diagnosis of malignancy. Lack of growth, and the maintenance of a sharply defined border would be roentgen evidence in favor of nonmalignancy. Erosion of the ribs or vertebrae by pressure in benign tumors would be sharply limited to the contour of the tumor shadow itself.

The location and distribution of the mass might indicate the point of origin. Massive density of the posterior mediastinum extending bilaterally with comparatively clear lung fields would favor mediastinal origin, especially if the lateral borders are smooth and clear-cut. Unilateral hilar involvement even with mediastinal density is more suggestive of primary bronchial carcinoma.

The differential diagnosis of metastatic processes is not usually a difficult problem. The roentgen-ray findings are frequently pathognomonic as in certain cases of metastatic sarcoma, or they are suggestive because of the distribution throughout both lungs. Even in the cases that simulate primary carcinoma, the history or the accompanying signs of the primary lesion usually make the differentiation.

Before discussing in particular the roentgen-ray findings in cases of primary carcinomata, we wish to emphasize the fact that stereoscopic views are of greatest value and should always be made. Increasing the tube-plate distance and making both anteroposterior and posteroanterior views will occasionally bring out small nodules that may be indistinct and diffused by a too divergent beam of rays. Lateral and oblique views often are of great value.

In diffuse carcinoma of the upper lobe, which most authors agree is most frequently involved, the lower border of the density is sharply outlined, the upper border fades out into the apex, which is usually comparatively clear.

Some cases of hilar carcinoma show a mass of density about the hilum with radiations extending outward along the bronchial branches but thinning out, sometimes abruptly, not far from the hilum. The lung parenchyma may be quite clear except for possibly a couple of nodules. From one of these peripheral nodules, there may be a triangular shaped area of density extending outward to the lateral chest wall, the nodule forming the apex of the triangle.

Other cases show a large massive shadow about the hilum. The outer border may be clear-cut and contrast sharply in density with the surrounding lung. The border is not, however, as smooth as in some of the mediastinal growths where the lung is pushed ahead of the growth.

Occlusion of the bronchial lumen in hilar carcinoma would produce atelectasis of the corresponding part of the lung and this area might resemble a pneumonic process, or there might be merely a veiling of the lobe affected.

Paracentesis should be performed in all cases in which there is a pleural effusion and then the case should be immediately roentgenographed especially if the fluid is sanguineous. The return of the fluid in malignant cases is usually rapid and within twenty-four hours may be the same in amount as before withdrawal. This is in itself suggestive of malignancy. The withdrawal of even a small amount of fluid may reveal nodules otherwise hidden.

We have not derived any special aid from the production of an artificial pneumothorax in the few cases where we have tried this procedure. In one case, not included in this series, the tumor showed up more clearly before the lung collapsed around it.

In cases where there appears to be a large amount of effusion present without displacement of the heart to the opposite side, one must consider the possibility of lung tumor. The heart is frequently found displaced to the affected side even in cases where almost the whole side is opaque. Later, when the tumor itself increases sufficiently in size, the heart may be displaced to the opposite side as in pleural effusion without adhesions. The conditions that would displace the heart to the affected side would be apt to result also in asymmetry of the chest, the affected side not expanding to the proper degree. The excursion of the diaphragm on that side would also be limited.

These findings, in the absence of symptoms of acute obstruction, and decreased transparency of one or more lobes, indicating collapse of the lung, should suggest the possibility of occlusion of an air passage by a growth of some kind. A bronchoscopic examination would be of value and material might be secured for histological study.

When small circular nodules of moderate density, larger than ordinary tubercles, and surrounded by fairly clear lung, are found, one must think of malignancy, especially if a couple of such nodules are found along the same branch, and the density of this branch is accentuated, as would result from a peribronchial lymph infiltration. The size, especially variation in size, and distribution, usually help in the differential diagnosis from tuberculous and other lesions. The usual characteristic mottled cloudiness of the parenchyma found in the ordinary case of pulmonary tuberculosis is of itself pathognomonic. It is furthermore often bilateral; primary lung carcinoma rarely so until the later stages. Then, the side primarily involved would be apt to show massive dense areas due either to the tumor itself or the secondary changes due to occlusion of the bronchi.

We have seen very marked hilar density with infiltration along the larger bronchi that clinically appeared to be due to syphilis. This type might be mistaken for malignancy. A comparison of roentgenographic findings and symptoms after a period of anti-luetic treatment would be very helpful in the final diagnosis. We believe this type of luetic involvement is extremely rare.

Hodgkin's disease and lymphosarcoma may simulate a hilar carcinoma very closely. Blood study, the involvement of superficial lymph nodes, and the rapid therapeutic reaction to mild roentgen radiation would help to establish the diagnosis.

In conclusion, we are reporting the history, symptoms, physical findings, roentgenograms and pathological reports of 8 cases of primary intrathoracic neoplasms, all of which were correctly diagnosed during life. An analysis of these will indicate the data upon which the diagnoses were based.

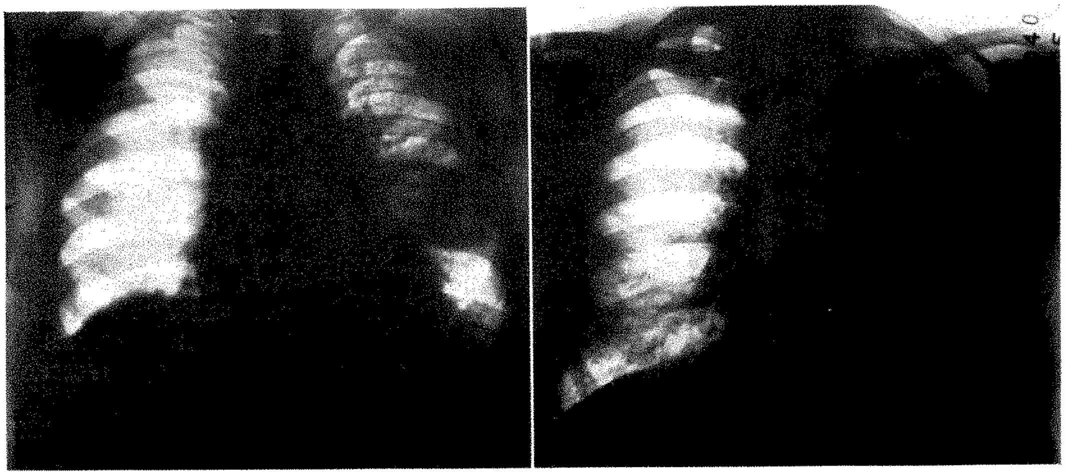
We wish also to emphasize that failure to resort early and routinely to careful roentgen-ray examinations of the chest will result in the failure to detect and diagnose a large percentage of intrathoracic neoplasms. In the earlier stages, before the complications of pleural effusion, compressed or fluid-filled lung, have taken place, the roentgenograms may be the more characteristic. In the later stages, the roentgenograms may still show pathognomonic evidences of lung tumor, or such an unusual combination of findings that suspicion of the presence of a lung tumor or other rare lesion is aroused and further investigation resorted to. Most cases of lung tumor with symptoms referable to the chest, can be correctly diagnosed if there is careful synthesis of the physical and roentgenographic findings together with a careful analysis of the clinical history. Even with absolutely negative physical findings, one cannot eliminate the diagnosis of an intrathoracic neoplasm with any degree of accuracy except with the supporting evidence of a negative roentgenographic examination. On the other hand, the routine roentgen-ray examination, especially in cases without symptoms referable to the chest, is the most accurate method we have of detecting the presence and the location and distribution of a consolidating process in the chest, the picture in some cases being characteristic enough to indicate the diagnosis. Roentgenograms made to study the progress of an obscure case furnish a permanent, more accurate, and more tangible basis for comparison than the recorded observations of changes in the percussion note and breath sounds. The interval examinations are, therefore, most valuable in the making of a differential diagnosis.

Case I. Male, landscape gardener, aged fifty-five.

Complaint. Slight shortness of breath and feeling of tightness under the sternum.

Physical Examination. Rales in both bases. Otherwise negative.

Roentgen examination, Jan. 6, 1923. (Fig 1). We are indebted to Dr. R. J. May, St. Luke's Hospital for the use of this roentgenogram. This plate shows a mass of uniform density about one and one-half inches in diameter in the lower portion of the upper left lobe, and uniform veiling of the upper two-thirds. The lower third is about as clear as the corresponding region on the right side. There is accentuation of the peribronchial shadows throughout the upper left lobe, with small nodular shadows along the branches. Increased density about left hilum. The right side is comparatively clear.


Figs. 1 and 2. Case I.

Admitted to Cleveland City Hospital June 4, 1923; discharged June 30, 1923.

Complaint. Shortness of breath which began about six months ago with associated cough. To prevent coughing he must sleep lying on the left side. Patient has some dull pain in the epigastric region. Exercise causes palpitation of the heart.

Physical Examination. Well-developed and well-nourished male of stocky build. Respiration is almost wholly right-sided, with respiratory retraction of the entire left costal margin. Percussion note uniformly flat over entire left side and fremitus considerably reduced. Heart displaced to the right. Breath sounds are diminished in intensity but are high pitched and tubular in character over the left chest.

Two hundred fifty c.c. of turbid fluid containing fine flocculi were aspirated from left chest; sp. gr. 1020; clot formed on standing, and it solidified on boiling. Microscopic examination showed clumps of cells larger than white blood cells, and some resembling giant cells. Culture of fluid showed no growth. A second tap yielded no fluid.

Temp., normal; resp., 20; vital capacity, 1600 c.c.; B.P. right arm, 122; B.P. left arm, 144; white blood cells, 10,600; hemoglobin, 80 per cent d.; urine, neg.; blood Wass., neg.; roentgen examination June 5, 1923 (Fig. 2). Left side of chest entirely opaque, except for slight thinning out of density toward apex. Heart retracted to affected side.

Second admission Dec. 23, 1923. Died Dec. 31, 1923. Patient never lost weight until three months ago. Used to weigh 160 lbs.; now weighs 105 lbs. Since last admission has had much pain in left shoulder but no limitation of motion in the joint. Has had considerable epigastric distress and condition has gradually grown worse. Physical findings in chest practically same as at last admission. Patient orthopneic and cyanotic.

Roentgen examination Dec. 29, 1923. Heart displaced to the right at least an inch beyond the position shown in the previous examination. Marked mottling along the bronchi in the lower half of the right lung, especially toward the base, which has developed since the previous examination. Asymmetry of chest. Left side contracted.

Autopsy. 450 c.c. chocolate-colored fluid encapsulated in pleura over anterior upper left chest. Pleural cavity obliterated. Diffuse carcinoma involving both lobes on left. Miliary carcinomatosis of middle and lower lobes on right side.

Case II. Male; laborer, aged sixty-four. Admitted to Cleveland City Hospital May 12, 1922; died June 6, 1922.

Complaint. Pain in the left side of face and forehead, of three weeks' duration.

Physical Examination. A well-developed and well-nourished Italian male. The left eye deviates to the nasal side and there is marked ptosis of the lid. No nystagmus. There is a hard firm nodule the size of a walnut attached to the upper end of the manubrium which was first noticed by patient four weeks ago. The left costal margin moves less than the right. Dullness at the left base with breath sounds distant or absent. Vocal fremitus impaired. One hundred c.c. of green turbid fluid aspirated from the chest, May 24, 1922. Biopsy of nodule from manubrium showed carcinoma.

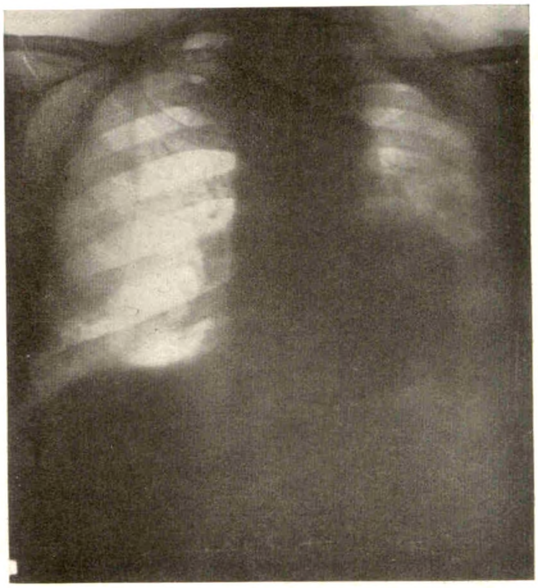


Fig. 3. Case II.

Blood and spinal fluid, Wass. neg; temp., 36.5°C. to 37.5°C. Terminal rise to 40°C. Pulse 70 to 100., resp. 18 to 22.

Roentgen examination (Fig. 3). Chest asymmetrical. Left side contracted. Heart retracted to left side. Dense shadow extending downward and outward from left hilum toward chest wall. At the outer portion, the shadow suggests a separate nodule. Just below this, there is another nodule about one-half inch in diameter. Upper left lobe filled with small nodular shadows scattered throughout the lower portion especially. Right side comparatively clear; complete absorption of the left second rib inside scapular line.

Autopsy. Hydropleura left side, 250 c.c. Lower left lobe airless and completely filled with tumor tissue. Large nodules in upper left lobe. A grayish mass at left hilum narrowing the lumen of bronchus of left upper lobe. Non-keratinizing squamous epithelioma primary in lung. Metastases to liver, both adrenals, sternum, clavicle and ribs.

Case III. Male; engineer, aged seventy-four. Entered Tuberculosis Sanatorium of Cleveland City Hospital, April 30, ~~1923;~~ died June 15, 1923.

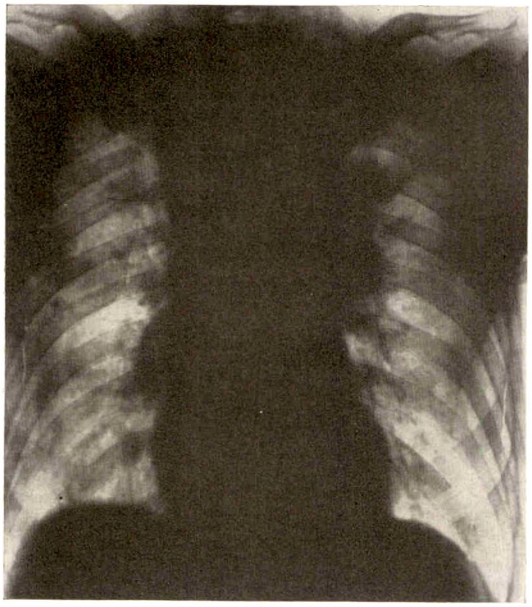


Fig. 4. Case III.

Complaint. Cough, loss of weight, weakness, pain in chest. Patient was well until nine months ago when he started to cough and lose weight. Has lost 50 lbs. since onset and has not worked for three months on account of weakness.

Physical Examination. A well-developed emaciated white male with pronounced anemia. Thorax symmetrical, dullness over left upper chest posteriorly and at angle of scapula on right. Extremely fine crepitant rales in first intercostal space anteriorly on left, and typical rales in both axillae. Breath sounds distant posteriorly over upper portion both sides of chest.

Temp., 37–38°, with afternoon rises; pulse, 75–110; resp., 22–36; R.B.C., 3,600,000; Hgb., 70 per cent.

Roentgen Examination (Fig. 4). Chest slightly asymmetrical. Right side contracted. Mediastinal shadow widened. Cavity at left apex. Large hilar mass on left with radiations and large, dense shadows scattered along bronchial branches. Mottling entire right side, particularly the upper lobe. Nodule at right base near heart.

One month later the roentgen examination gave the following fiindings: Cavity left apex. Extension of hilar shadows. Small nodule seventh interspace and directly below it, another in the ninth. Mottled density on right side at base.

Autopsy. Large mass at left hilum, many firm tumor masses in upper left lobe. A few in lower lobe. Nodules throughout entire right lung. Cylindric-cell carcinoma. Caseous mediastinal glands. Tuberculosis both sides with cavity in left apex.

Case IV. Male, dancing instructor, aged fifty-two.

Entered Tuberculosis Sanatorium of Cleveland City Hospital Aug. 17, 1922, and died Oct. 21, 1922. His complaint was weakness and pulmonary hemorrhages. His past history was negative except for diphtheria in childhood; he denied luetic infection.

Complaint. Present illness started six months ago with loss of strength and cough, no fever, no night sweats. One month ago he had lost 10 lbs. in weight and three weeks ago he had his first hemorrhage, "about a glass and a half of blood." Two days ago he had another hemorrhage.

Physical Examination, Oct. 14, 1922. A well-developed white male, quite anemic and emaciated with dry and inelastic atrophic skin. Pupils sluggish, right slightly irregular. The right supra-claviular and infra-clavicular fossae deeper than the left. Right upper chest flatter than the left. No undulation on left but some on the right, however, the costal margins flare but slightly. Percussion note impaired over left upper chest anteriorly and posteriorly and over right hilus posteriorly. Breath sounds distant but high pitched with prolonged expiration over left upper chest. No rales heard anywhere. During the patient's stay in the sanatorium he had repeated pulmonary hemorrhages varying in amount from 1½ ounces to 1½ pints. Thirteen sputum examinations were negative for tubercle bacilli. Blood Wassermann, 4 plus. Blood pressure, 114/70. Temperature curve was irregular, sometimes as high as 38.5°C., with intervals of several days in which there was absence of fever.

Roentgen Examination, June 1, 1922 (Fig. 5), shows triangular-shaped shadow ln the left hilum with base toward the median line. At the apex, there appears to be a separate nodule about three-fourths of an inch in diameter. Slight veiling of upper lobe of left lung. Lower half about as clear as corresponding portion of right. Heart was displaced.

We are indebted to Dr. J. E. Olivenbaum for this plate. The patient did not come under our observation until four months later.

Four months later, Oct. 14, 1922 (Fig. 6), there was marked asymmetry of chest. Left side contracted. Uniformly dense in middle portion, thinning out slightly toward apex and very markedly toward left costophrenic angle, which is comparatively clear.

Autopsy. Several small nodules in left main bronchus. Occlusion of bronchus to left upper lobe by a pulpy mass 5 × 3 cm. in diameter. Dilatation of bronchi beyond occlusion, and atelectasis of lung. Metastasis to a paratracheal lymph node, 3 × 2 × 2 cm. in diameter. Bronchial carcinoma.

Case V. Male, farm laborer, aged forty-three.

Entered Tuberculosis Sanatorium of Cleveland City Hospital, Jan. 7, 1923, and died March 29, 1923.

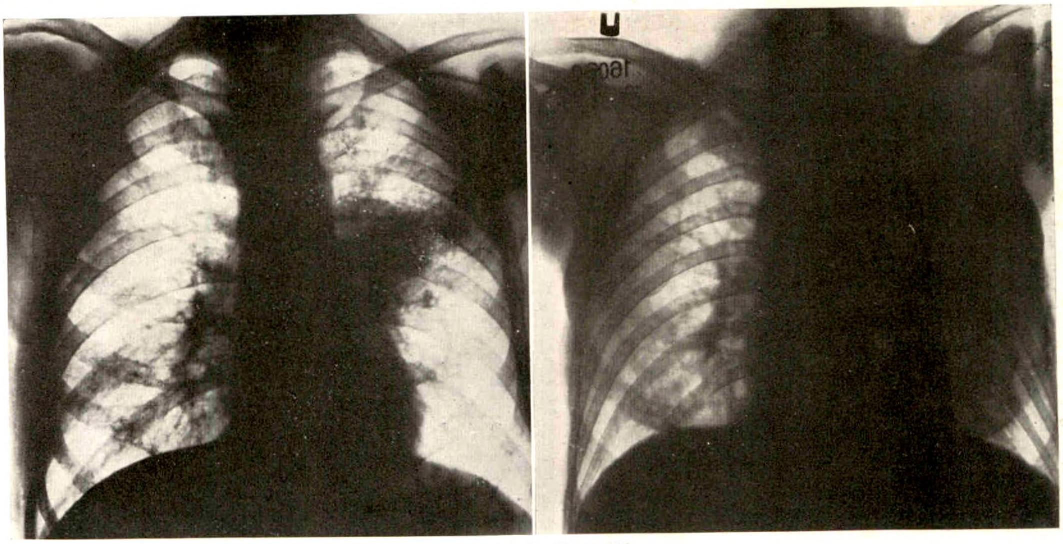
Complaint. Pain in chest, cough, weakness, fever, night sweats and shortness of breath. The onset of these symptoms was three months ago and they had increased in severity. No history of pneumonia.

Physical Examination. A white male in fair state of nutrition. Whole left chest moves less than right. Left apex fairly resonant but rest of chest is dull, with absence of breath sounds or distant tubular breathing. Tactile fremitus diminished throughout left chest, absent at base.

Irregular fever, skin dry, lips parched. Pus of pea soup color was aspirated on two different occasions—15 c.c. and 160 c.c. The patient was transferred to surgical service and a rib resection done Jan. 16, 1923. A small amount of pus was found. Drainage was never profuse and for two weeks before death the discharge was a brownish thin fluid. The sputum and the pus from the chest were negative for tubercle bacilli. Left chest was flat to percussion but no further fluid obtained when needled.

Temp., 36-39°C.; pulse, 65-138; resp., 18-40; hgb., 85 per cent.

Roentgen Examination. Chest asymmetrical. Left side contracted, and heart retracted to left. Left side uniformly opaque, except for slight thinning out



Figs. 5 and 6. Case IV.

toward apex and base where drainage tube has been inserted. Right side comparatively clear.

Two months later. Chest asymmetrical. Left side now larger than right, and mediastinal contents displaced markedly to the right. Left side uniformly dense.

Autopsy. Obliteration left pleural cavity by dense adhesions. Heart and mediastinum displaced 5 cm. to right. Entire left lung solid, airless, with area of necrosis in which was found a drainage tube. Nodules on visceral and parietal pleura. Pulmonary vein filled to its point of entrance into the auricle with tumor tissue.

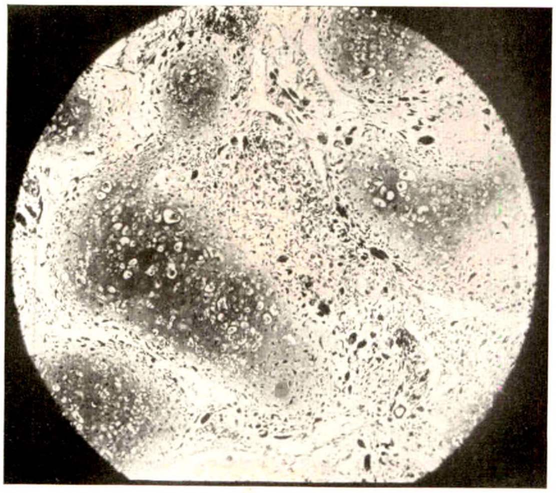


Fig. 7. Case VI.

Carcinoma—primary in lung with metastasis to right adrenal, and to mediastinal and prevertebral lymph nodes.

Case VI. Male, colored, laborer, aged forty-one.

Entered Cleveland City Hospital Jan. 22, 1923, and died Feb. 13, 1923.

Complaint. Pain in right chest, cough, bloody expectoration, shortness of breath, loss of weight, loss of appetite, insomnia, and weakness. These symptoms began ten weeks ago and he has gradually grown worse. Had malaria and swamp fever during childhood in Mississippi. Had chancre twenty years ago, pleurisy four years ago and influenza three years ago.

Physical Examination. Well-developed emaciated male who is restless and uncomfortable; dyspneic, but not cyanotic. The right side of the thorax is decidedly larger than the left. Motion on the right side markedly restricted. Slight displacement of the heart to the left. Dullness on the left from clavicle downward. Tactile fremitus markedly diminished over dull area and breath sounds are absent. Diminution of vital capacity marked. Liver dullness four finger breadths below costal margin but no nodulation felt. Abdomen distended with free fluid. The veins of the right arm distended and both sides of face edematous. Superficial hyperesthesia extends from right nipple down to umbilicus. This hyperesthesia extends laterally on right to mid-clavicular line and to the posterior axillary line on the left.

Temp., 36.5° C. to 38.6° C.; pulse, 80–120; resp., 20–32; urine, neg.; Wass., neg., W.B.C., 9,200 to 11,400; R.B.C., 3,584,000; Hgb., 55 per cent., vital capacity, (sitting) 1,200.

Biopsy. Fragments of tissue aspirated by needle diagnosed chondrosarcoma by Dr. H. T. Karsner.

Roentgen Examination. Shows a massive uniform density of most of the right chest. The density fades out toward the costophrenic angle. The upper border of density is at the level of the fourth interspace posteriorly. It is sharply outlined and curved with the convexity upward. The lung field above is comparatively clear, except for moderate density compared with the corresponding field in the left lung. The left lung shows nothing unusual.

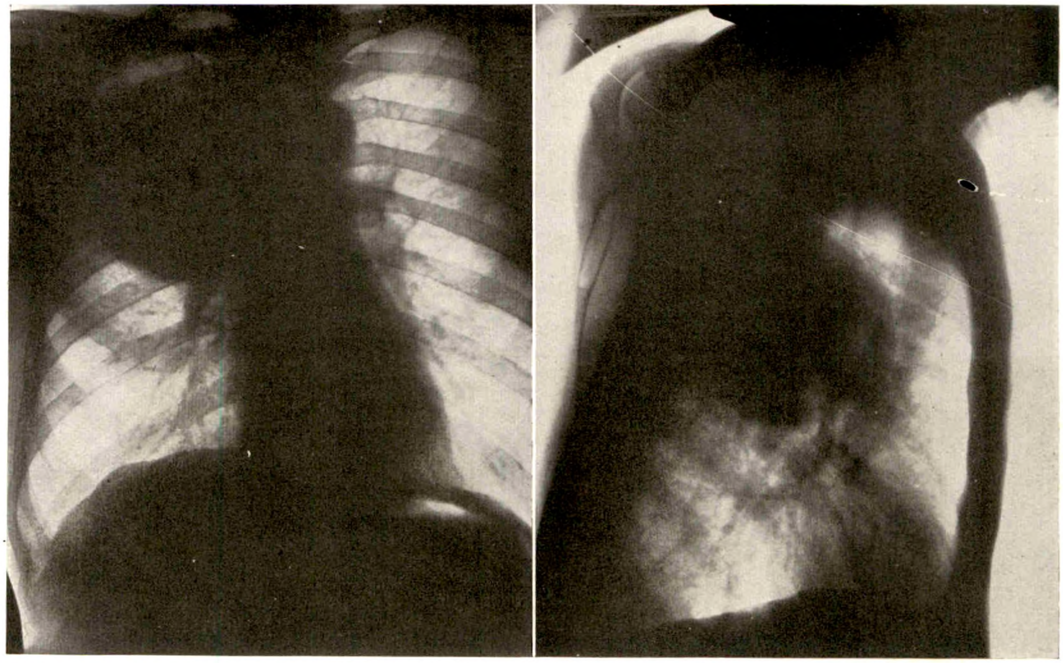
Figure 7 is a high power microphotograph of the tumor showing area of embryonic cartilage cells and also mature cells undergoing calcification.

Autopsy. Chondrosarcoma involving pleura, middle and lower lobes of right lung. Displacement of heart and mediastinum to left. Displacement of diaphragm downward. Compression of both cavae. No metastases.

Case VII. Male, newspaper editor, aged thirty-three.

Complaint. Pain in right upper chest, of five year's duration, worse when tired or during change of weather. Three years ago consulted well-known internist and on his negative findings patient took up Christian Science, "with much relief from pain and improvement in general health."

Physical Findings. Negative, March, 1919. No physical signs detectable until five months after the presence of the tumor was discovered by routine roentgen examination.



Figs. 8 and 9. Case VII.

Roentgen Examination. March, 1919 (Fig. 8). The plate shows asymmetry of chest. Right side contracted. There is a circumscribed globular shadow of even density about 12 cm. in diameter occupying the location of the lower portion of the upper right lobe. The left side of the chest is negative.

The lateral view (Fig. 9) shows this spherical mass located toward the posterior part of the chest. The border is smooth and sharply demarcated. This case was examined by some of the leading internists of the country immediately after these plates were made and no physical signs of a tumor could be found.

We are indebted to Dr. C. S. Hoover of Alliance for the subsequent roentgenograms and the history of this case.

Ten months later the roentgenogram showed increase in size of this growth and the development of a similar tumor springing from the hilum below. The oblique view shows the lower tumor more clearly.

Patient was operated upon by Dr. George Heuer of Philadelphia in May, 1920. A large vascular tumor was found which could not be removed. Large needle was inserted and tissue aspirated for biopsy, and was diagnosed endothelioma (Bloodgood and McCallum).

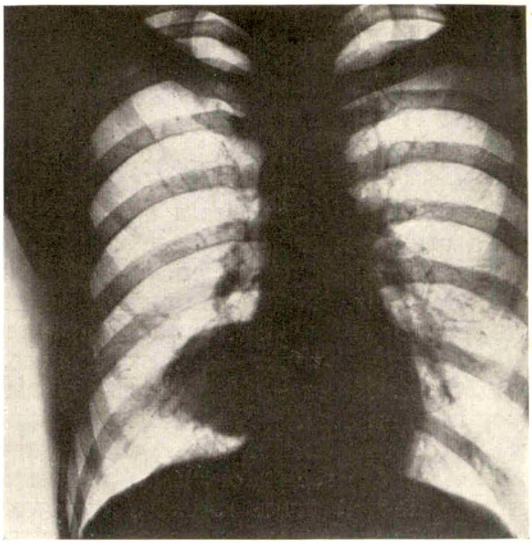
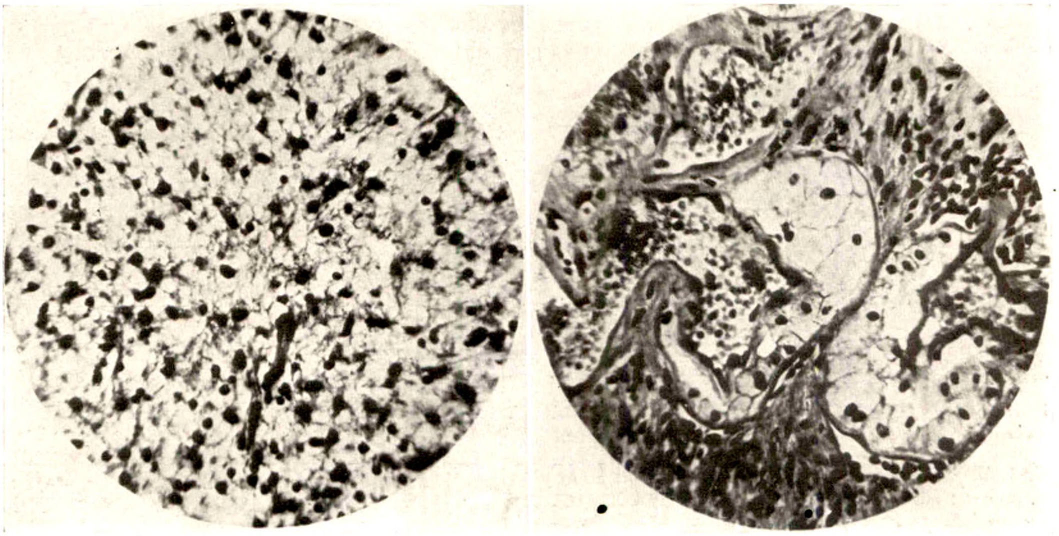


Fig. 10. Case VIII.

The last plate made fifteen months later than Figure 8 shows that the upper tumor fills almost the entire right side of the chest except the apex. The lower tumor extends almost to the costophrenic angle. There is a small area of aereated lung at the lateral chest wall between the upper and lower tumors. The heart and aorta are displaced markedly to the left. The left lung remains clear.

Patient died July 8, 1920.

Autopsy. Tumor mass filled up entire right chest displacing diaphragm downward and the heart to left.



FIGS. 11 and 12. Case VIII.

CASE VIII. Male, physician, aged twenty-nine. Jan. 15, 1919.

Complaint. Fifteen years ago patient had a sharp stabbing pain in the lower right quadrant of abdomen. The attack lasted ½ hour, leaving the region tender and sore for a few days. Similar attacks followed every three or four months. Violent exercise or sudden chilling would precipitate an attack. If a slight blow was received in mid-portion of the chest, pain was felt in the region of the 10th dorsal vertebra and at times radiated to lower right abdomen. There was never any fever. Seven years ago a normal appendix was removed with no relief of symptoms. It was impossible to rest or sleep in any position except flat on the abdomen. Roentgen examinations of the gastrointestinal tract were negative. The mass in the chest was discovered eight months ago when a film was taken for other reasons. A needle was introduced into the growth in hopes of finding fluid if it were a cyst. None was obtained. The needle puncture produced a sharp shooting pain, extremely severe in the right lower abdomen, of the same type experienced in the attacks for the past fifteen years.

Figure 10 shows a dense rounded mass about two inches in diameter, arising apparently from the tenth rib on the right side close to the spine. The lateral view, shows a circumscribed border with apparently a capsule, there being a very thin zone of transparency, on the outside of which there was an adjoining thin line of density. On account of the smooth contour from all aspects and the long duration indicated by the history, a diagnosis of benign tumor was made. The possibility of cyst had been eliminated previously by puncture.

The tumor was removed with complete relief of symptoms. The pathological diagnosis was xanthoma by Drs. Bloodgood and MacCallum.

Figure 11 shows a microphotograph of the tumor.

Figure 12 shows the high power microphotograph of typical foam cells.

We are indebted to Dr. Geo. Heuer for the use of these beautiful microphotographs.

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ABSTRACT OF DISCUSSION

Dr. Baetjer stated that he had found it quite impossible to differentiate the infiltrating type of carcinoma of the lung from tuberculosis or resolving pneumonia, by the roentgen evidence alone. He cited 6 cases of the infiltrating type of the disease in which the roentgenologist's report was wrong. The diagnosis in these cases must be made, if made at all, upon other than the roentgen findings.

Dr. Pancoast described the progress of the lesion in a case of epithelioma of the apical pleura. It produces an early erosion of the first three ribs and later an erosion of lower ribs and the vertebrae. The patient is generally referred to the roentgenologist because of pain in the shoulder, and cervical ribs may be suspected.

Very early there is only slight opacity in the apex and later increasing with uniform density until it appears to involve the entire lung. It is in reality, however, a tumor of the pleura. The symptoms of this condition often simulate tumor of the spinal cord.

Dr. Holmes emphasized the fact that although it may be impossible to make a definite diagnosis between tumor, tuberculosis, and other diseases, still the roentgen examination does show the presence of a lesion, and directs the clinician's attention to it. This is of great importance in those cases that give no clinical evidence of their presence.

DANGER IN PRESCRIBING BARIUM SULPHATE

It has been brought to the attention of the Safety Committee of the American Roentgen Ray Society that several deaths have occurred throughout the country during past years because of the use in roentgen examinations of the digestive tract of soluble or impure barium preparations instead of pure barium sulphate, which is insoluble. Barium sulphate for internal use must be specially prepared in order to remove all soluble barium salts, such as the chloride, etc.

Barium sulphate is a substance not often prescribed and seldom called for by individuals in drug stores. On the other hand, barium sulphide is a well-known depilatory, is easily obtained from any drug store and is extremely poisonous when taken internally.

In order to avoid the possibility of the occurrence of mistakes in the future, it is suggested by the Safety Committee that no prescriptions be written for barium sulphate and that patients be not instructed to obtain this substance from drug stores for internal use. If it is considered absolutely necessary to give a prescription it should be labeled plainly as follows: "This is to be taken internally and must be filled only with barium sulphate specially prepared for internal use." Another alternative is to prescribe bismuth subcarbonate which is satisfactory as an opaque medium for roentgen examinations and which does not present the same opportunity for mistakes as is the case with barium sulphate. There is, of course, no intention to discourage the use of barium sulphate in roentgen laboratories of institutions or in the private offices of roentgenologists.

A CASE OF HODGKIN'S DISEASE, WITH LATE DEVELOPMENT OF SACROILIAC DISEASE, CURED BY ROENTGEN TREATMENT*

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THIS case is of especial interest because of the extensive glandular and mediastinal involvement, which gradually disappeared completely under roentgen-ray treatment. After all glandular disease had disappeared, a tumor appeared over the left hip, which seemingly was associated with a destructive disease of the sacroiliac joint. This tumor in the hip and the sacroiliac disease disappeared almost like magic after a single exposure to the roentgen rays. The term "cure" is, of course, used in the sense that the visible disease has disappeared, for no one has yet determined how many years must pass before a case of Hodgkin's disease can be considered really cured. In fact, we are not yet sure whether any of them are permanently cured. We present the case more for criticism and discussion than as representing any special skill or technique on our part.

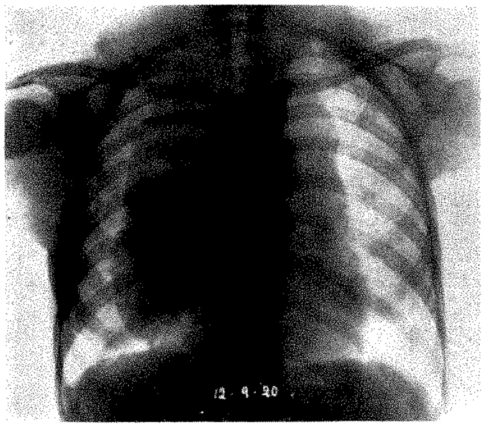

FIG. 1. Dec. 9, 1920. Shows extensive mediastinal tumor; also the tumor tissue in the right axilla and in both sides of the neck before treatment.

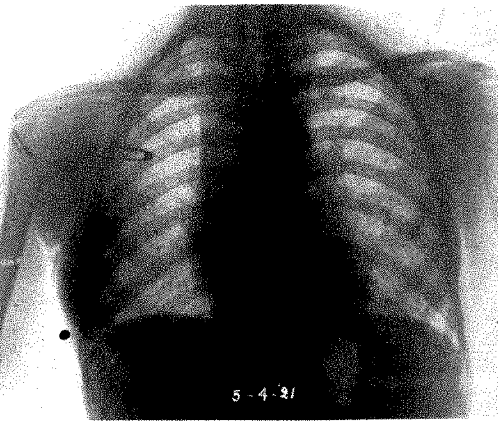

FIG. 2. May 4, 1921. Shows remains of mediastinal tumor five months after beginning treatment, the tumor tissue being reduced to about one-tenth.

Briefly, the history of this case is as follows:

Female, aged sixteen, was admitted to the Medical Service of the Misericordia Hospital, under Dr. W. F. Monaghan, who referred her to the roentgen-ray department for examination and treatment December 9, 1920. Swelling of the glands on the right side of the neck had been noticed by the patient first during December, 1919. Under local applications they disappeared and returned again to a considerable size by July, 1920. The glands became progressively larger and rapidly involved also the left side of the neck and both axillae. They were not painful and the patient had no subjective symptoms.

The patient was of small stature, somewhat emaciated, pale or anemic in appearance, with extensive lymphatic tumors in the right side of the neck, consisting of isolated glands of uniform consistency, making a mass the size of a fist. There was about half as much glandular tissue on the left side of the neck, and a group of glands in each axilla, making a mass about the size of a hen's egg, larger on the right than the left. None was palpable in the abdomen or groins. There was no evidence of softening and no tenderness. There were none of the appearances usually found in tuberculous adenitis. There had been no menstruation since December, 1919, a period of seven months.

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* Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 24–26, 1924.

The sputum showed no tubercle bacilli. The examination of the nose, throat and tonsils by Dr. McCarthy showed nothing abnormal.

Roentgen examination showed a large mediastinal tumor mass equal nearly to that of the patient's head. The tumor shadow was continuous with the shadow of the heart and together with the cardiac shadow occupied about one-half of the chest cavity. The outline was smooth and sharply defined. There was no evidence of pulsation. The lungs were clear. The heart shadow was normal.

The Wassermann test was negative. The blood examinations were as follows:

Dec. 9, 1920. R.B.C. 3,430,000; W.B.C. 14,200; H., 65; P. 71; T. 5; Lymph. 22; E. 2. June 22, 1921. R.B.C. 3,830,000; W.B.C. 8,200; H. 80; Poly. 82; S.L. 10; L.L. 8. Sept. 20, 1922. R.B.C. 4,050,000; W.B.C. 8,200; H. 78; Dr. Kenney. Jan. 16, 1923. R.B.C. 3,780,000; W.B.C. 5,600; H. 75; P. 64; T. 2; Lym. 32; E. 2.

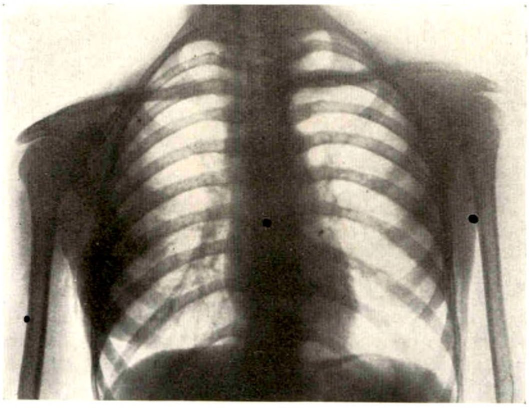

Fig. 3. June 6, 1923. All palpable tumor tissue has disappeared and the mediastinum is normal. Patient at this time returned with a tumor on the outer and posterior portion of the thigh. See Figure 4.

A section of the cervical glands studied by Dr. J. D. Paul showed Hodgkin's disease.

The treatment consisted of the application of roentgen rays over each of the glandular areas, using a 9 in. parallel spark gap, 5 ma. at 40 cm. distance for 40 min., with a filtration equivalent to 6 mm. of aluminum. Each side of the neck, the axillae and the anterior and posterior surfaces of the chest were exposed, crossfiring as much as possible on the mediastinal tumor. Five applications were made over each area within a period of eighteen months.

There was a progressive reduction of the tumor tissue, and a progressive improvement in the patient's general health. Her appetite improved, weight and strength increased and her pallor disappeared. Her menses reappeared April, 1921, about nine months after beginning treatment, despite the fact that two applications of the rays had been made over the abdomen.

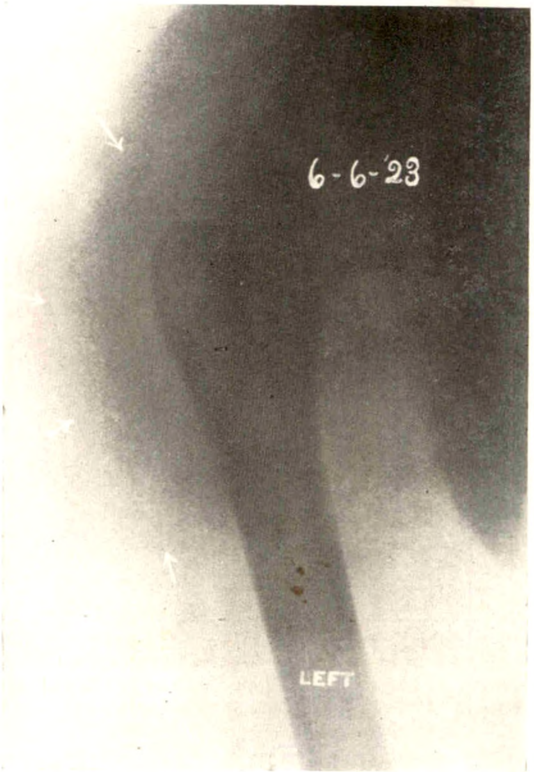

Fig. 4. June 6, 1923. Shows the distention under the fascia lata. Tumor felt quite solid. No fluctuation. See Figure 5.

On June 22, 1921, or eleven months after beginning treatment there was no palpable disease. The mediastinum still showed tumor tissue, which had been reduced about two-thirds. April 26, 1922, the patient seemed to be well, though there was still slight evidence of disease in the upper mediastinum. The patient then remained apparently well for about a year.

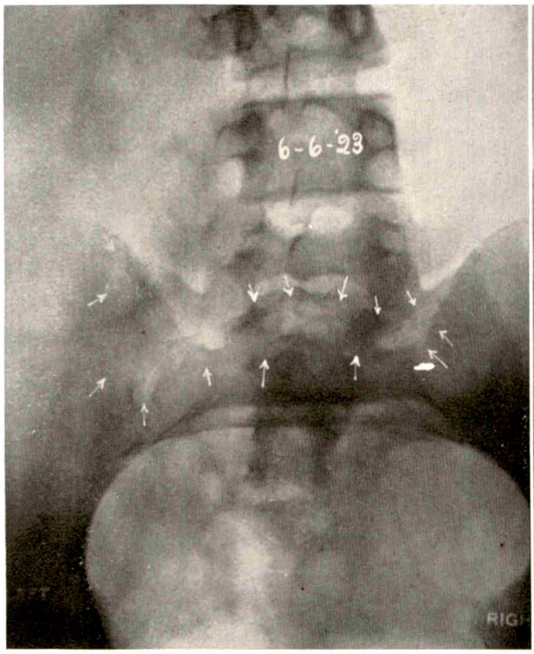

Fig. 5. June 6, 1923. Shows destruction of the upper portion of the sacrum and extending from the inner border of the right sacroiliac joint to the left sacroiliac joint where the disease involves 1 in. of the inner portion of the left ilium. The disease resembles tuberculosis except that it is sharply defined.

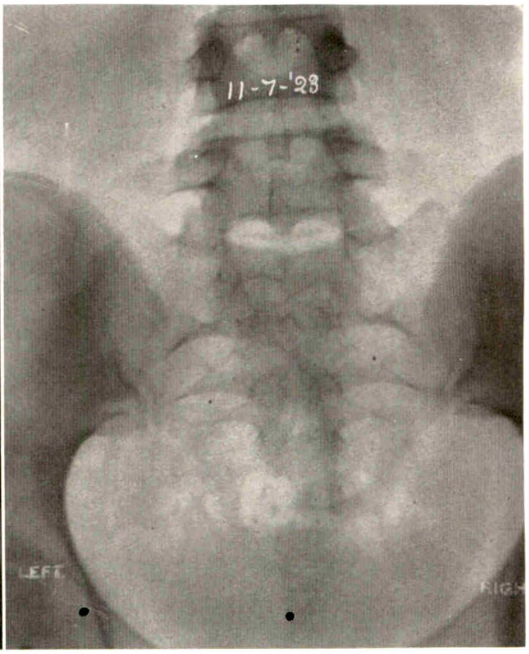

Fig. 6. Nov. 7, 1923. Shows restoration of the sacrum and sacroiliac region to normal after one application of the roentgen rays, no treatment having been given over the femur, this single treatment consisting of a 9-in. spark gap with 5-ma., 40-min. exposure at 40 cm. and filtered through 6 mm. of aluminum. At this time the patient seems to be thoroughly healthy in every respect. The response seems too prompt to be considered tuberculous.

June 6, 1923, two years after beginning treatment and one year after stopping active treatment, she returned for examination on account of a tumor which had formed over her left hip, lying posterior to the greater trochanter, about the size of a small banana, but quite hard, suggesting bone. Roentgen examination showed no disease of the hip bones, and the tumor shadow was of the density of soft tissue. It then occurred to us that perhaps we were dealing with a drainage abscess and we made an examination of the sacroiliac region. We found a destructive disease of the upper portion of the left sacroiliac joint, involving an area about 1 in. in diameter. It was sharply defined and did not have the appearance of tuberculosis, which is usually not sharply defined and is associated with atrophy of the adjacent bone. At the time, however, we looked upon it as tuberculosis, because we could not give it any other name. At that time, there were no palpable lymph nodes and the mediastinal tumor had entirely disappeared.

On June 15, 1923, knowing nothing better to do, we gave a dose of roentgen rays similar to that described above. No treatment was given to the tumor on the left thigh, which was probably a "cold abscess." When she returned on August 9, the tumor had entirely disappeared and roentgen examination of the sacroiliac region showed the bone healed. A second dose of roentgen rays was applied on this day before the film had been developed.

Remarks. This patient had the typical clinical and roentgenographic appearance of Hodgkin's disease. It has disappeared completely (apparently) under the influence of the roentgen rays. This disappearance under roentgenotherapy is common.

The appearance of the sacroiliac disease and a gluteal abscess afterwards, however, is not common, and the rapid disappearance of the sacroiliac disease and the gluteal abscess after about two-thirds of a full erythema dose of roentgen rays is truly remarkable. Dr. O'Boyle has reviewed the literature and can find no similar case on record.

If this bone disease is tuberculosis, we would have an argument in favor of early roentgen treatment of such disease, instead of waiting for all other methods to fail and only using the rays in the most chronic and obstinate cases of bone or joint tuberculosis. If this bone disease were a part of the Hodgkin's disease, the rapid response would not be remarkable, but one would have to change the entire idea of Hodgkin's disease. If others have had similar experiences, they should be recorded.

DISCUSSION

Dr. Pancoast, Philadelphia. I have seen what I thought was bone involvement in Hodgkin's disease on one occasion a number of years ago, and the appearance was rarefaction of the bones, very much as indicated in the slide shown. It occurred around the shoulder girdle, and that patient had very severe pain in his arm and around the shoulder. He was in the terminal stage of Hodgkin's disease, having been one of the glandular enlargement cases, and died not very long afterwards. I think in another instance I have seen it, but I am not certain. I know that case particularly well, and I have never seen any reports of similar cases since. I thought since that time that I was possibly mistaken in taking that for Hodgkin's disease, but I am very glad to hear of another case. I believe it can occur.

Dr. Quick, New York City. We had a case sent to us last year by an orthopedic surgeon with a tentative diagnosis of bone sarcoma in the dorsal region. On going into the history we found that that man had been treated three years previously and for some time after that at one of the other hospitals in town for Hodgkins' disease, and nodes had been obtained which verified the diagnosis. We verified it subsequently, so there was no question as to the original condition. The patient had been treated very efficiently. When she came in she had severe pain with clinical evidences of bone involvement in the mid-dorsal region. The plate showed definite destruction of the bone. I felt rather suspicious of the diagnosis as sent, in view of the previous Hodgkin's history. Dr. Herendeen was very certain it was not an osteogenic tumor and that it was probably not tuberculous. It had rather a hollowed out appearance. I presume the explanation was just this, that the patient had been well-treated originally; that the huge mediastinal mass had contracted and when the disease lighted up locally again it could not proceed anteriorly; in other words the dense fibrous tissue held it in that direction and there was a pressure or erosion of the bone from it. We had hoped for several months to get an autopsy but were unable to do so.

Dr. Stern, New York City. We have in the Roosevelt Hospital at the present time a patient with very extensive Hodgkin's disease which presented abscesses on the dorsum of the foot which were finally opened and formed at one time a draining sinus. There was local destruction of the second metatarsal bone. The glands are improving very satisfactorily. We have recently radiated this lesion in the foot, and at the present time it looks as though we are obtaining a very definite result from that.

Dr. Holmes, Boston. I have not had any cases exactly like these, but we have seen some very unusual complications following Hodgkin's disease that have been treated over a long period of time; that is, we have seen things we thought resulted from an enlargement of the lymphoid tissue in unusual conditions. One patient had severe pain down the leg, but there was no evidence of anything in the bone such as Dr. O'Boyle's case shows. We did find later a growth in the spinal canal which pressed on the nerve root. That was proven by operation, and that the enlargement was a true Hodgkins' enlargement.

Dr. Pfahler: In the bone?

Dr. Holmes: No, it was in the spinal canal and pressed on the nerve root and gave very severe pain. We have also had two cases which developed brain symptoms resembling very much epileptic attacks, one of which was proven by operation to have enlargement of the lymphoid tissue of the brain, which is not supposed to be there, but it was found, and proved to be Hodgkin's disease. I think we must be on the lookout for unusual occurrences in these cases that have been irradiated over a long period of time. In this case reported, might not the bone destruction be due to pressure from a mass of glands in the pelvis, rather than to disease of the bone?

Dr. Pfahler: There were no glands in the pelvis, the patient had never been treated down there and there were none ever palpable; we looked for them.

Dr. Holmes: Do you think you could find then if they were there?

Dr. Pfahler: Certainly, any that were large enough to cause pressure.

Dr. Holmes: We have had cases come to autopsy with masses of glands deep down in the pelvis that we were not able to feel while the patient was alive; and then glands in the spinal canal certainly would not be palpable and yet would produce pressure and possibly necrosis in the bone. The patient that I mentioned came to operation because we radiated in the wrong place; his gland was much higher up. If we had radiated in the right place we ought to have reduced that gland.

Dr. Herendeen, New York City. I can recall two cases in which there was gross destruction of bone immediately beneath the mass of nodes of Hodgkin's disease. In one case the destruction occurred in the lumbar vertebrae with a mass of retro-peritoneal nodes that infiltrated also through all coats of the aorta. A section revealed multiple nodular enlargement. There was a large area of gross bone destruction, apparently not due to pressure, but to direct invasion. Another case came to autopsy and showed a large mass of nodes overlying an area of bone destruction in the pelvis. Recently I saw a case of Hodgkin's disease verified by a section of a node taken from the supraclavicular region, in which apparently metastasis had occurred. I use the word metastasis because there was no well-marked mass overlying a large area of destruction in the external condyle of the right femur. This patient's pain was relieved to a great extent by a small dose of roentgen ray over that area.

Dr. Manges, Philadelphia. I want to cite a case that seems to be very much along this line. There was one added feature to it that has not been mentioned in connection with the other cases. A young man who undoubtedly had Hodgkin's disease, verified by a study of the section, and who responded very promptly to roentgen treatment and to all appearances was cured; about 6 months later, perhaps less than that, returned to the hospital running a rather high temperature. There were absolutely no physical signs of any lesion in the chest or elsewhere. Pain in the back developed very rapidly, and following that there developed paralysis of the lower limbs and of the bladder and colon functions. I examined the spine, the lumbar and the dorsal regions very carefully, and could find absolutely no sign of any bone change. Paralysis became constantly more and more marked. The temperature gradually came down. Infection of the bladder, and in fact of the entire urinary tract, ensued and the patient died. I begged them to let me treat the patient or at least to treat the back, thinking that he probably had a spinal tumor, but I must admit that I did not associate it with the original condition of the Hodgkin's disease, but I think in view of what has been discussed here, it must have been the same thing. I would like to know if these other cases reported of spinal lesions in these cases have been associated with high temperature?

Dr. Pancoast, Philadelphia. I think we have all seen peculiar manifestations of Hodgkin's disease. Dr. Holmes mentioned a case in which there was an intra-spinal metastasis or growth of Hodgkin's. I have seen the same condition requiring a laminectomy, which proved the presence of the condition. Another case in which, after the disappearance of all glands, the patient suddenly developed exophthalmus on the other side, which also disappeared after radiation. It has been my experience that herpes zoster is a very frequent complication in the course of Hodgkin's disease, probably due to some nerve pressure, and even after we are apparently rid of all the growths which are visualized by the roentgen ray or discovered by palpation. There seems to be no end to the number of manifestations, and I feel very firmly convinced that we do have the bone manifestations. I think we should always make sure that the condition is Hodgkin's disease by resorting to biopsy. I do not think there is any danger in the removal of a gland which is near the surface in order to have it examined by a competent pathologist.

These observations indicate that radiation is capable of restraining the growth of tumor cells without causing either autolysis or necrosis, and of transforming functionless lawless cell growths into more organized and functioning tissues. This action is exerted also on proliferating connective tissue and on a wide variety of simple inflammatory and functional hyperplasias, and forms the basis of radiotherapy in many diseases outside the realm of tumors. If these deductions are correct, then this property of radiation is an extremely important addition to general therapeutics. For the first time in the history of medicine we are in possession of an agent which will control the growth of connective tissue. This tissue is the main element in the lesion which underlies many chronic and practically irremediable diseases, so that the search for such an agent has been the faint hope of pathologists for many decades. Aside from the practical question of its successful application, this property of radiation is of very great scientific interest. For this property we may safely conclude that its action is both specific and selective. Normal tissues and organs are distinctly less sensitive than neoplastic and hyperplastic. Even normal lymph-nodes resist radiation when inflammatory hyperplasias yield readily. We may also claim that its action is SECUNDUM NATURAM, *in that when properly employed it inhibits that reaction in excess which Weigert emphasized as the significant physiological element in productive inflammation and which exists also in many neoplasms. We have thus reviewed three main principles of radiation therapy which appear to be fundamentally different, each of which is selective, specific and tends to support natural processes of defense. These are:*

From An Analysis of Radiation Therapy in Cancer. The Mütter Lecture by James Ewing, in Radium Report of the Memorial Hospital. (Second Series, 1923.)

PRIMARY CARCINOMA OF THE GASTROINTESTINAL TRACT ACCOMPANIED BY BONE METASTASIS*

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IT has long been known that tumors involving certain organs have a tendency to metastasize to the osseous system. Tumors of the thyroid, prostate, and breast, and hypernephroma are frequently accompanied by bone metastasis.

Carcinoma of the gastrointestinal tract, however, is not included in the tumors that usually cause bone metastasis, and the literature is very limited in dealing with this subject.

From the work done at the Mayo Clinic by Dr. Moore one case of metastatic carcinoma of the bones following carcinoma of the gastrointestinal tract has been reported. His series covers 65 cases distributed as follows: Breast, 36; prostate, 11; kidney, 7; thyroid, 7; vulva, 1; sigmoid, 1; uterus, 1; abnormal masses of unknown origin, 3; primary source not discovered, 3.

Kaufmann, in his treatise on gastrointestinal carcinoma, gives the following percentages with regard to bone metastasis: 309 cases of carcinoma of the stomach showed 2.5 per cent bone metastasis; 101 cases of esophageal carcinoma showed 6.9 per cent; 57 cases of carcinoma of the rectum showed 10.5 per cent.

Schlesingers reports 54 cases with metastatic growths in the vertebrae. The primary tumors were as follows: Breast, 10; esophagus, 9; thyroid, 9; uterus, 6; bronchus, 5; stomach, 4; prostate, 3; gallbladder, 2; ovary, 1; sigmoid, 1; rectum, 1; kidney, 1; pancreas, 1.

Baetjer and Waters in their book on "Diseases of the Bones and Joints" do not mention the gastrointestinal tract in their discussion of bone metastasis. Ewing in "Neoplastic Diseases" mentions only briefly the possibility of bone metastasis accompanying gastrointestinal carcinoma.

In reviewing the literature, a total of 41 cases showing osseous metastasis following carcinoma of the gastrointestinal tract was found. The 41 cases were distributed as follows: Stomach, 32; gall-bladder, 3; rectum, 2; bile-ducts, 1; appendix, 1; pancreas, 1; colon, 1. In 17 of the 41 cases a definite history of pain in the bones was given, and in 4 of the cases fractures were present. The vertebrae seemed to be the favorite site of metastasis, and the lesions were, as a rule, multiple. Twenty-five of the reported cases showed vertebral metastasis. In only 13 of the cases was only one bone involved. It seems that the bones distal to the elbow and knee are very infrequently the site of metastasis. In none of the cases reported did we find mention of lesions in the ulna, radius, tibia or fibula. The ages of the patients ranged from twenty-one to sixty-four, the average being forty-three. The sex was named in 25 of the cases, divided, 17 males and 8 females.

Carcinoma of the esophagus is characterized by the variety and obscurity of its symptoms, peculiarities of the structures and its high mortality. About 75 per cent of the cases occur in males, and the average age is around fifty. Kaufmann, however, reports a case in a woman of ninety, and Himnan in a girl of fifteen. The favorite points of predilection are the cricoid, the aortic arch, tracheal bifurcation, crossing of the left bronchus, and the cardia. Anomalies in the mucous membrane of the esophagus such as the interruption of the squamous epithelium by the islands of mucous glands resembling glands like those of the stomach, make the two conditions very similar and hard to differentiate microscopically.

The usual types are: (1) The flat infiltrating ulcer; (2) the bulky polypoid of globular mass; (3) diffuse infiltration which may encircle the entire esophagus. The growth is prone to extend into the larynx and stomach and may even rupture into the trachea. Early and extensive metastasis usually occurs, probably due to the abundant blood and lymphatic supply. The most common metastasis is by extension. Dürr, however, reports a case of metastasis into the muscles over the pubic bone.

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In our series of cases we have encountered one primary carcinoma of the esophagus with bone metastasis. The secondary lesions were located in the lumbar vertebrae and obviously did not occur by extension.

Case I. Male, white, aged sixty, entered St. Luke's Hospital complaining of difficulty in swallowing solid foods. Liquids were swallowed with practically no difficulty or feeling of fullness. The dysphagia came on very acutely; three weeks prior to admission to the hospital he had experienced no difficulty. The dysphagia was accompanied by a great deal of pain which seemed to be relieved after swallowing the initial mouthful. The family history was of no importance. The Wassermann reaction was negative. The blood count was as follows: 3,930,000 red cells, 9,400 whites, and 85 per cent hemoglobin. The differential count showed 21 per cent small lymphocytes, 2 per cent transitionals and 68 polymorphonuclears. Blood pressure, systolic 150, diastolic 80. The physical examination revealed an enlarged liver which extended downward two finger breadths below the costal margin, and which was very tender on palpation. There were a few small palpable lymph glands in the cervical region. The lower lumbar spine was very tender on palpation. The reflexes were normal. The prostate was normal on palpation.

The day following admission a roentgen-ray examination of the gastrointestinal tract was ordered.

Roentgen Findings. The upper half of the esophagus is dilated to about twice its normal size. There is a definite stricture involving the middle third of the esophagus. The lumen of the stricture is very irregular and measures 1 cm. in diameter and is about 2 in. long. The lesion has the physical characteristics of malignancy.

While in the hospital the patient complained of severe pain in the lumbar spine. The following day an orthopedist was called in and carefully examined the spine. At his suggestion, a roentgen examination was made. The report was as follows: "There are definite areas of bone rarefaction which have the appearance of destruction involving the third and fourth lumbar vertebrae. The articular surfaces of the vertebrae seem normal in outline. The pathology seems confined to the bodies, which have a moth-eaten appearance. In lieu of the carcinoma of the esophagus I am inclined to believe the process is due to metastatic malignancy."

The difficulty in swallowing became progressively worse. The patient finally refused all solid foods and only after much persuasion would he attempt to swallow liquids. His condition also became progressively worse and on November 7 he died.

The post-mortem findings were as follows: Carcinoma involving the middle third of the esophagus with necrosis. Metastatic carcinoma of the liver, dorsal and lumbar spine, ribs, lungs, and retroperitoneal, tracheo-bronchial, posterior mediastinal and biliary lymph glands.

The *stomach* is the most frequent site of cancer in males. In 1912, a total of 46,534 people died of cancer in the United States. Of this number 39.75 per cent or 18,517 had cancer of the stomach. According to the United States census of 1911, 61.2 years seems to be the average age in which cancer of the stomach occurs. It may occur, however, at a very early date. Osler and McCrae report 10 cases in children under ten years of age. The adenocarcinoma seems to be the type that usually attacks the young. Cullingworth reports an adenoma in an infant five weeks old. According to certain statistics, about 60 per cent of all stomach carcinomata occur at the pylorus, 20 per cent along the lesser curvature and 20 per cent along the greater curvature. The fundus is rarely involved. In Welsh's report of 1,200 cases, the distribution was as follows: Pylorus 60.8 per cent; lesser curvature 11.4 per cent; cardia 8 per cent; posterior wall 5.2 per cent; diffuse 4.7 per cent; multiple tumors 3.5 per cent; greater curvature 3.6 per cent; anterior wall 2.3 per cent; fundus 1.5 per cent.

Kaufmann classifies tumors of the stomach into six types:

(1) Bulky adenocarcinoma.
(2) Gelatinous carcinoma.
(3) Carcinoma following peptic ulcer.
(4) Carcinoma simplex; diffuse carcinoma.

(5) Diffuse scirrhous carcinoma.

(6) Sclerosing carcinoma.

Welsh, in reviewing 1,331 cases, gives the following classification: 791 or 64.8 per cent were medullary; 399 or 32.7 per cent scirrhous; 31 or 2.5 per cent colloid.

In our experience, bone metastasis following carcinoma of the stomach is very rare. In going through our records we were unable to find a case of gastric carcinoma accompanied by bone metastasis. In a review of the literature of the 41 cases showing bone metastasis following carcinoma of the gastrointestinal tract, 32 or 78 per cent followed carcinoma of the stomach.

Carcinoma of the small bowel is comparatively rare. In 3,000 complete gastrointestinal examinations, the essayist has recognized only 4 cases. Buel, in 3,563 malignancies of the intestines found only 89 or 2.5 per cent in the small bowel. Guser says 4 per cent of all carcinomata of the intestines occur in the duodenum. He reports 71 cases of carcinoma of the duodenum distributed as follows: 11 in the first portion, 51 in the second, and 9 in the third. The second portion, accordingly, is the favorite site. The lesions occur late in life, usually after sixty. Rolliston reports 35 cases of duodenal carcinoma. Eight were located in the first part, 24 in the second, and 3 in the third. Carcinoma of the jejunum and ileum is exceedingly rare. About 3 per cent of all carcinomata occur in the ileum and jejunum. The lesions usually occur early; 46.5 years is the average age, and the predilection increases near the stomach and large bowel. In none of the 42 reported cases showing bone metastasis was the primary malignancy located in the small bowel.

Carcinoma of the large bowel is comparatively common, especially in the later years of life. The incidence seems higher in the rectum and sigmoid than in the proximal colon. In the writer's experience, about 50 per cent of all malignancies of the large bowel occur in the rectum and sigmoid. The number of cases occurring at the flexures has been very small; only 4 have been recognized by the essayist. The Pathological Institute at Vienna, reports 343 autopsies showing carcinoma of the intestines from 1870 to 1893. The distribution was as follows: Colon 164; rectum 162; duodenum 7; ileum 10. Schleips, in his report of 596 autopsies of the intestinal tract, locates the malignancies as follows: colon, 259; rectum, 257; duodenum, 20; ileum, 60. Kaufmann reports 115 cases of carcinoma of the large bowel with the following distribution: colon, 36; sigmoid, 28; rectum, 51. He further states that 60 per cent of intestinal carcinomata are located in the rectum and that 5.25 per cent of all carcinomata are located in the rectum.

Karte, in 297 large-bowel malignancies reports 47 in the cecum, 22 in the ascending colon, 19 at the hepatic flexure, 44 in the transverse colon, 31 at the splenic flexure, 10 in the descending colon and 124 in the sigmoid. Although cancer of the large bowel usually occurs in the late years of life, cases have been reported as early as three years of age by Clar. Nothnagel reports a case of carcinoma of the colon at the age of twelve, and Garrard, a carcinoma of the sigmoid at the age of twelve.

In 4 of the 5 cases of the essayist's series, the carcinomata were located in the large bowel, namely, cecum, 2; sigmoid, 1; rectum, 1. The ages ranged from fifty to sixty; 2 were males and 2 females. The 4 cases were of low grade, slow growing types with late metastasis. The bone metastasis occurred about two years after the original diagnosis, confirmed at biopsy.

In our experience there has been a preponderance of metastases into the vertebrae, which is in accord with the cases reported in the literature. In 3 of the large-bowel malignancies we have noted changes in the vertebrae. The proximal third of the femur also seems to be a favorite seat of metastasis. All 4 cases showed definite lesions in the femora.

The osteoclastic type of metastasis has been the more common; in 3 of the cases the lesions were definitely destructive, while in 1 they were of the osteoblastic type. The patient showing the osteoblastic type of metastasis had a primary carcinoma of the cecum. The metastasis had the physical characteristics of the changes so often found following cancer of the prostate. In fact, two very competent roentgenologists made such a diagnosis. The changes were quite extensive. The left humerus, left scapula, ischii and pubis were involved. During the month of October, 1922, a definite area of destruction occurred in the middle third of the left tibia, this being the only case to show metastasis below the knee (Fig. 1). The pain has been very severe in all cases, and morphine has been resorted to, to relieve the suffering. The careful use of the roentgen ray does, in a large measure, control the pain, temporarily at least.

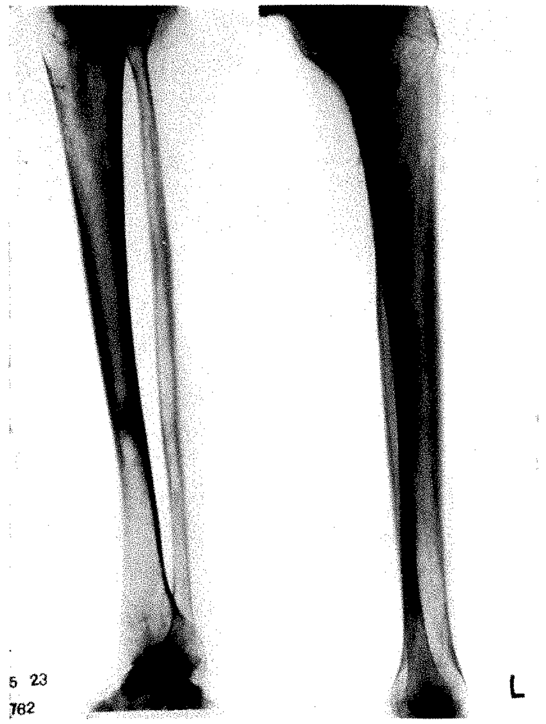

Fig. 1. Our only case which showed metastasis below the knee.

In some of the osteoclastic type cases after roentgen therapy, the lesions take on the physical characteristics of the osteoblastic type. The bones may become very dense and have the appearance of an osteosclerosis. Whether this is a favorable change, I am not prepared to say. The patient's general condition shows no great improvement, and the pain still persists. It seems reasonable to assume, however, that the process is influenced by the rays. The malignant cells are inhibited, at least, and in turn the osteoblasts may be stimulated and form new bone. The transformation or histological change may at least produce an extension of life, as the osteoblastic type does not progress so rapidly as the osteoclastic type. The above statement is only tentative as the series of cases is too small to draw any definite conclusions. We can say, however, that the case showing the osteoblastic type of metastasis survived the patients with osteoclastic changes.

Case II. Male, white, was first seen on April 23, 1919, complaining of nocturnal epigastric distress. The distress had been present for the past year and was particularly severe about 2 A. M. At no time during the year had he experienced any nausea or vomiting. The distress had no relation to the taking of food and there had been no appreciable loss of weight. The bowels had been quite regular, as a rule, one movement a day. Some months previous, the patient had noticed the stools were of a tarry color.

Past History. The patient's father died at the age of seventy-two. The cause of death was said to be sarcoma. The mother died at the age of fifty-eight, cause unknown. Patient gave no history of venereal infection. Eight years ago patient had his appendix removed, and three years ago a hemorrhoidectomy. No other facts of importance were ascertained.

Physical Examination. The head and neck showed nothing of importance. The lungs were emphysematous, but otherwise normal. The apex of the heart was located 1 in. to the left of the nipple line. A systolic murmur was heard all over the precordium. The blood pressure measured systolic 125, and diastolic 73. The liver was 3 in. below the costal margin and was quite firm, but not tender on palpation. The spleen could not be palpated. There was marked tenderness over the epigastrium and colon. The prostate was slightly enlarged but no nodules could be felt and no tenderness was elicited. The urine showed a slight trace of albumen with a few hyaline casts. The stools showed no occult blood. The stomach analysis showed no free acid, either with Ewald or motor meals. The blood picture was as follows:

Reds, 4,000,500; whites, 9,900; hemoglobin, 72 per cent.

The roentgen-ray examination of the gastrointestinal tract, at this time showed no evidence of a lesion. The patient improved clinically for a time under diet and medical management. Eight months later, the hemorrhoids began to bleed. In December, 1919, on proctoscopic examination a polyp was found and later removed. The histological report was as follows: The microscopic structure of a polyp is present in the tissue. The surface epithelium is columnar epithelium of the mucous cell type. While there is no infiltrating growth in the tissues, these tumors are regarded as mildly malignant and tend to recur. Diagnosis: Rectal polyp; carcinoma.

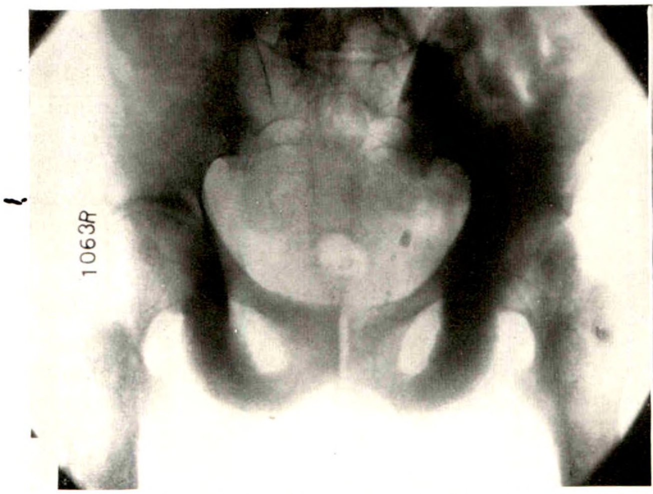

FIG. 2. Osteoblastic type of metastatic malignancy in pubis and ischium.

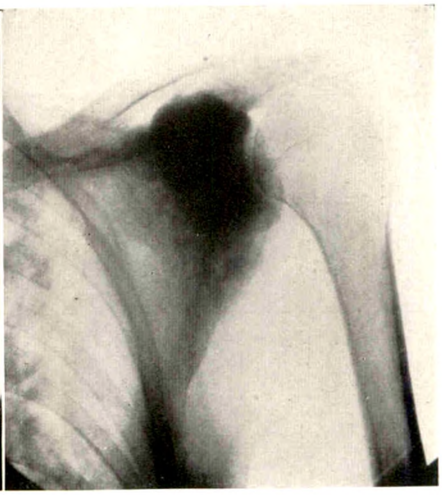

FIG. 3. Same case as Figure 2. Metastatic carcinoma of the shoulder.

On January 19, 1920, a barium enema revealed the following: the colon fills readily showing no filling defects in the rectum, sigmoid, distal or transverse portions. The distal colon is very spastic especially in its proximal half. The flexures are normal in outline and position. The transverse and ascending colons are normal in outline and position. The upper half of the cecum fills very readily and seems quite normal. The tip of the cecum fills with great difficulty and is definitely irregular in outline. The filling defect was very definite, but it was thought advisable to re-examine the patient two days later, to rule out any chance of the defect being due to fecal matter. The examination showed the filling defect still present. The following diagnosis was made: Filling defect involving the tip of the cecum which is probably due to a malignancy.

The first week in February, 1920, the patient was operated on by Dr. L. L. McArthur. The entire cecum was removed with about 3 in. of the terminal ileum, and the ileum was anastamosed to the hepatic flexure. At the time of the operation no evidence of any glandular involvement was found. The pathological report was as follows: Carcinoma of the cecum. Material: The specimen is the cecum of the large bowel extending upward a distance of 4.5 cm. There is also the terminal 7.5 cm. of the small bowel. The appendix has been removed. Immediately above the scar of the appendix is a cauliflower growth about 6 cm. in diameter which fills the cecum and extends into the ileocecal valve. In places the tissue is very indurated. Histology: Sections of the tumor contain infiltrating islands of tubular epithelium. In places these are circumscribed and their lumina contain mucoid material. No carcinoma was found in the sections of the lymph glandular tissue removed.

For two years following the operation the patient's general health was very good. In January, 1922, the patient returned to the hospital complaining of severe pain in

SYNOPTICAL TABLE OF CASES OF CANCER OF THE INTESTINAL TRACT WITH BONE METASTASIS FOUND IN THE LITERATURE

Case No.	Reported by	Reference	Age	Sex	Site of Primary Cancer	If bone pains observed	If fracture of bone	Metastasis	Remarks
1	Sailer & Taylor	Internat. Med. Mag., 1897, vi, 404.	45	M	Stomach Ca. very small	....	....	Pancreas, glands and bone marrow.	Lowest red blood corp. 1,000,000. 9% myelocytes.
2	Otto Frese	Deut. Arch. f. Klin. Med., 1900, lxviii, 387–404.	28	F	Stomach carcinoma	Yes	No	Lungs, liver, pleura glands, sternum, vertebrae, ribs, femur.	Lowest R. B. C. 681,000 8% myelocytes. Spleen enlarged.
3	Ibid	Ibid.	26	M	Stomach	Yes	No	Lungs, brain, glands, ribs, vertebrae, skull, pelvis.	Lowest R. B. C. 800,000. No myelocytes. Spleen unchanged.
4	Kurpjuweit	Ibid, 1903, lxxvii, 553–578.	34	F	Stomach epithelioma	Yes	No	Liver, pancreas, glands, vertebrae.	Lowest R. B. C. 718,000 11% myelocytes. Spleen enlarged.
5	Ibid	Ibid.	42	M	Stomach carcinoma	....	No	Liver, glands, vertebrae.	Lowest R. B. C. 4,320,000 4% myelocytes.
6	Ibid	Ibid.	51	F	Bile ducts carcinoma	Yes	Yes	Glands, ovaries, thyroid pleura, kidney, adrenal-lines, ribs, vertebrae, sacrum, sternum.	Lowest R. B. C. 3,200,000 17% myelocytes. Spleen enlarged.
7	J. Arneth	Zeitschr. f. Klin. Med., 1904, liv, 238.	25	M	Stomach scirrhous cancer	....	....	Lungs, liver, spleen glands, vertebrae sternum.	Lowest R. B. C. 1,072,000 7% myelocytes.
8	M. Zade	Beitr. z. path. Anat., 1904, xxxvii, 568.	33	M	Stomach carcinoma	Yes	....	Skull, vertebrae, ribs, sternum, clavicle, and abdomen.	Lowest R. B. C. 2,944,000 40% myelocytes. Showed bilateral pupillary stasis.
9	Schleip	Zeitschr. f. Klin. Med., 1904, lix, 261.	34	M	Appendix colloid cancer	Yes	....	Glands, mesentery, vertebrae, sternum.	Lowest R. B. C. 4,452,000 7% myelocytes. Spleen enlarged.
10	Ibid	Ibid.	33	M	Stomach epithelioma (latent and very limited)	Yes	....	Vertebrae, ribs, pelvis, skull.	Lowest R. B. C. 1,084,000 7% myelocytes. Spleen not enlarged.
11	Goetsch	Beitr. z. path. Anat., 1906, xxxix, 218.	47	M	Rectum carcinoma	Yes	No	Glands, liver, kidney, lungs, sternum, skull, right femur.	Adenomatous metastasis.
12	Ibid	Ibid.	63	F	Gall-bladder carcinoma	....	....	Liver, pancreas, skin, mesentery, omentum, glands, skeletal system (skull vertebrae R. femur, ribs).	
13	Ibid	Ibid.	62	F	Gall-bladder carcinoma	....	....	Glands and vertebrae bodies.	
14	Naegeli	Quoted by Stempetinum in Med. Klin. Berl., 1908, iv, 704.	45	M	Stomach carcinoma	Yes	No	Liver, vertebrae, sternum.	Lowest R. B. C. 2,168,000 8% myelocytes. Spleen not enlarged.
15	Wolfer	Ibid.	37	M	Stomach carcinoma	....	....	Liver, lungs, pancreas, femur vertebrae.	Lowest R. B. C. 1,550,000 4% myelocytes.
16	Luzzato	Acc. Med. di Parma Feb. 28, 1908 and quoted by Har[illegible]ngton & Teacher.	45	M	Stomach cancer	....	....	Carcinomatous nodules in various parts of the bone marrow of the vertebrae.	Grave anemia. Myeloid reaction of blood. Original report not available.

17	Parmentier & Chabrol	Bull et. Mem. Soc. Med. d. hop. Paris, 1909, xxviii, 341.	45	M	Stomach scirrhous cancer	Yes	No	Glands, femur, marrow.	Lowest R. B. C. 1,040,000 8.6% myelocytes. Hb. 60% spleen enlarged.
18	Perls	Allg. Pathol. II, Aufl., p. 332.			Stomach fibrous carcinoma	Yes	....	Glands, pancreas, lungs, lumbar vertebrae and 5th rib.	Epithelial structure in metastasis.
19	Harrington & Teacher	Glasgow Med. Jour., 1915, lxxxiii, 115.	59	F	Stomach carcinoma	Yes	No	Glands, ribs, right femur, left humerus.	
20	Harrington & Teacher	Glasgow Med. Jour., 1910, lxxiii, 241.	64	F	Stomach scirrhous cancer	Yes	Yes	Glands, omentum, ribs, femora, humerus, kidney, pancreas.	Lowest R. B. C. 1,600,000 5% myelocytes.
21	Harrington & Kennedy	Lancet, London, 1913, i, 379.	52	M	Stomach scirrhous cancer	Yes	No	Glands, sternum, ribs, and femora.	Lowest R. B. C. 2,325,000 3.8% myelocytes.
22	Parkes Weber	Quoted by Ward in Proc. Roy. Soc. of Med., 1913–1914, Med. Sec., p. 141.	32	F	Stomach carcinoma	No	No	Liver, suprarenals, glands, humerus ovaries.	Lowest R. B. C. 1,056,000 11.4% myelocytes. Spleen not enlarged.
23	Middleton	Glasgow Med. Jour., 1913, lxxxiii, 274.	49	M	Stomach adenocarcinoma			Sternum, ribs, right femur, vertebrae, suprarenals.	
24	Jack & Teacher	Glasgow Med. Jour. 1918, lxxxix, 81.	58	M	Stomach carcinoma	Yes	Yes	Sternum, manubrium, ribs, left femur, vertebrae.	Lowest R. B. C. 3,390,000
25	Helmrich	Deut. Med. Wchnschr.	33	M	Stomach carcinoma	Yes	No	Vertebrae, sacrum, cranial.	Lowest R. B. C. 2,500,000.
26 to 33	Deelman	Nederland Tyssch v, Geneesk, 1921, ii, 1048 (8 cases).	Not	Stated	Stomach carcinoma	....	....	Bone metastases were vertebral; majority of cases and associated with visceral metastasis.	37 cases of bone metastasis were found in 528 autopsies of cancer patients.
34	....	(1 case).	..	..	Colon carcinoma	....	....	With metastasis in vertebrae and sternum.	
35	....	(1 case).	..	..	Pancreas carcinoma	....	....	Metastasis in vertebrae.	
36	....	(1 case).	..	..	Rectum carcinoma	....	....	Vertebral metastases.	
37	....	(1 case).	..	..	Gall-bladder carcinoma	....	....	Vertebral metastases.	
38	Rohrer	Ewing Neoplastic diseases.	..	..	Stomach carcinoma	....	Yes	Femur metastases.	
39	Panatelli & Carvaillon	Progres. Med., Apr. 14, 1906.	..	..	Stomach carcinoma	....	....	Cranial bones.	
40	Panatelli & Carvaillon	Progres. Med., Apr. 14, 1906.	..	..	Stomach carcinoma	....	....	Cranial bones.	
41	Tilling	1899 Osler.	..	..	Stomach carcinoma	....	....	Humerus.	
42	Jenkinson	1923.	60	M	Esophagus carcinoma	Yes	No	Lumbar spine.	
43	Jenkinson	1923.	62	M	Cecum carcinoma	Yes	No	Scapula, Ischium.	White count 2,300. Mass in abdomen. Lung metastasis.
44	Jenkinson	1923.	47	F	Sigmoid carcinoma	Yes	No	Femur.	Ascites. Complete obstruction. Severe pains in bones.
45	Jenkinson	1923.	64	F	Rectal carcinoma	Yes	No	Ribs, spine.	Semi-comatose condition for two months.
46[1]	Jenkinson	1923.	60	F	Cecum carcinoma	Yes	No	Ribs, spine.	Severe pain in spine.

the pelvis and thighs. Roentgen examination at this time showed what was thought to be an osteoblastic type of malignancy in the pubis and ischii (Fig. 2). Roentgen therapy was immediately instituted and continued at frequent intervals, until January, 1923. The treatment seemed to control the pain, and for a number of months his condition was such that he could carry on his business. During March, pain developed in the left shoulder, which, on roentgen examination was found to be due to a metastatic carcinoma (Fig. 3). In October the patient's condition became decidedly worse and he was obliged to remain in bed. In spite of heavy roentgen therapy the pain persisted, and seemed to travel from one place to another. About the time the pain in the shoulder was under control, the pain in the pelvis and femora would become acute. During the month of January, 1923, a large mass developed in the abdomen, and the lungs showed what was thought to be secondary carcinomata. The patient's condition became progressively worse, and during the first week in April, 1923, he succumbed. An autopsy was not obtained.

Case III. Male, white, entered the hospital June 28, 1922, complaining of pain in the back.

In July, 1921, the patient was operated at Mayo Clinic for carcinoma of the rectum, at which time a colostomy on the left side was done. Since the colostomy the bowel movements have been very sluggish. The first of February, 1922, severe pain in the back developed, which extended down the right thigh and leg. On April 29, 1922, the patient was operated for an acute appendix. At this time the peritoneal cavity contained many enlarged glands which on section were carcinomatous.

The patient entered the hospital primarily for roentgen therapy. Films taken at this time showed no evidence of metastasis in the lumbar or dorsal spine or in the femora.

Roentgen-ray treatment was started and was distributed over a period of ten days. The pains down the legs improved for a time, but the improvement was only temporary, and in two weeks the pain was again very severe. For two weeks following the treatment a severe diarrhea developed and blood was found in the stool. The patient's condition became progressively worse, and the frequent use of morphine was necessary to control the pain. Food was refused, and the patient became delirious. For the next two months the patient remained in a semi-comatose condition, and on October 30, 1922, succumbed. The autopsy showed extensive metastases into the lungs, liver and spine, with a primary carcinoma of the rectum.

Case IV. Female, white, aged forty-seven, entered the hospital November 9, 1921, complaining of swelling and pain in the abdomen. The pain was especially well marked in the right lower quadrant and down the right thigh. Previous to June, 1921, she had enjoyed very good health; at this time an uncontrollable diarrhea developed which continued through the summer. During this time the patient went to stool twelve times daily. The bowel movements were watery and reddish in color. The swelling of the abdomen became more pronounced and the pain was very severe on turning from side to side. There seemed to be no pain on the taking of food. Frequent urination was complained of, and for the past six weeks she had suffered from a severe cystitis. The past history regarding the diseases of childhood was negative.

Family History. Mother died at the age of fifty-six from epilepsy; father died at the age of seventy of cancer; three sisters living and well; one brother aged sixty, living and well; one brother died at the age of fifty-six. There was no history of tuberculosis in the family.

Menstruation began at the age of fourteen, regular until 1918. Married twice, never pregnant.

Physical Examination. The head, neck, heart and lungs are negative. The abdomen is large and tense, contains fluid and is very tender on palpation. The size corresponds to about a seven months' pregnancy. In the lower right quadrant there is a mass about the size of an orange which is very tender on palpation.

On November 11, 1921, the abdomen was opened and a large cyst of the ovary removed. A month following, the patient was sent home. The pain, however, was still present. While at home, the abdomen became larger, and on January 31, 1922, she returned to the hospital suffering from an acute obstruction of the larger bowel, probably the sigmoid. The patient had taken very little food, and suffered a great deal from vomiting. Roentgen-ray examination at this time showed an absolute obstruction at the junction of the sigmoid and pelvic colon. The lumen of the bowel was very irregular, and a diagnosis of a malignancy was made. On February 4, 1922, the abdomen was opened by Dr. Fred Besley, and a large mass involving the sigmoid was found, which proved to be a cancer. The distal colon was brought up, and a colostomy performed. The colostomy relieved the obstruction, but the pain in the abdomen and down the thigh still persisted. The pain grew progressively worse and large doses of morphine were given. Very severe pain developed in the upper third of the femur. The roentgen-ray examination of the femur showed definite mottled areas in the neck and upper third, which had the appearance of metastatic carcinoma (Fig. 4). The femur was examined from time to time, and the process rapidly progressed. The roentgen-ray reductions show the progress very clearly (Fig. 5).

During the last six months of the patient's life, seven to eight grains of morphine were necessary to relieve the pain. On February 19, 1923, the patient died. No post mortem was obtained.

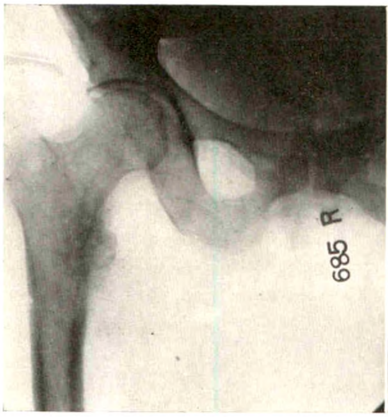

Fig. 4. Case IV. Metastatic carcinoma of the neck and upper third of the shaft of the femur.

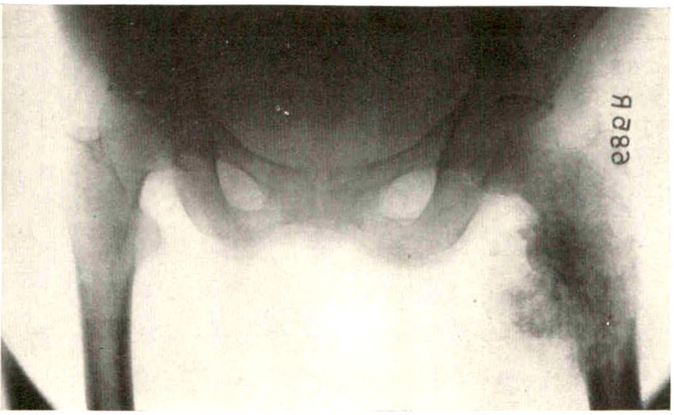

Fig. 5. Case IV. Taken at a later date than Figure 4.

DISCUSSION

Dr A. B. Moore, Rochester, Minn. The diagnosis of metastasis has proven a question of considerable difficulty, in my experience. I have met with considerable difficulty in differentiating the osteoplastic type from Paget's disease of the bone. I would like to ask Dr. Jenkinson if he has any distinctive points in the differentiation.

Since the advent of the grid I will say without hesitation that I think we have been able to obtain more satisfactory examinations. The perplexing thing to me in the osteoplastic type of metastasis is the atrophy from non-use that you get in people that have been hospitalized for a long period. The osteoporosis that we see there makes it very difficult always to establish the diagnosis of bone metastasis. I would like to ask Dr. Jenkinson whether he has ecountered this.

Dr. S. Clark, South Bend, Ind. I would like to report 1 case that Dr. Moore's remarks called to mind. A man thirty-eight years of age, a farmer, was working about his yard and standing on an ordinary saw horse about 2 ft. high; the saw horse tipped over and the man stepped down onto his feet. At the time he had a little discomfort, but went about his affairs. The next morning he had pain in the lower lumbar region which gradually grew worse with flexion of the right leg. The flexion increased and later he consulted a chiropractor, who treated him for some weeks, three weeks, I believe. He then came in to our office for a roentgen examination. We found what we believed to be a fracture of the fifth lumbar vertebra; there was also evidence of an osteoclastic process. The man was advised to be hospitalized and placed in bed for the treatment of this fracture. Almost immediately he began to vomit and have stomach symptoms. The history then developed that the man had had slight symptoms of indigestion during the previous year, but nothing that interfered seriously with his health. Following the development of the vomiting a roentgenographic examination was made of the gastrointestinal tract, which revealed what we believed to be an extensive carcinoma of the upper two-thirds of the stomach. There was no interference with the emptying time of the stomach, and no involvement of the pylorus. An exploratory operation was made, and an extensive mass was found in the stomach, microscopical sections of which proved it to be a carcinoma. The man had a negative Wassermann. He died two weeks after the exploratory operation from continued vomiting and exhaustion. There was no microscopical examination made of the vertebrae, but in the light of the history and from the roentgen appearance of this vertebra, we believed it to be a metastatic carcinoma of the fifth lumbar vertebra.

The interesting feature was that the man had no stomach symptoms whatever until after he had had the fracture of the vertebra.

Dr. Jenkinson, closing. Attempting to answer Dr. Moore's question regarding Paget's disease, I will say that in the few cases we have seen the pathology occurs in the tibiae and the skull. The patient is usually about forty-seven years of age.

The changes in both the tibiae and the skull are, I believe, quite characteristic, and should not be confused with metastatic carcinoma of the bones.

Instead of a breaking down and osteoplastic changes, there is more apt to be a great deal of new bone-formation. This is especially true of the vault of the cranium.

In the cases we are reporting, the microscopical findings showed definite carcinoma involving the cecum and sigmoid. The microscopical findings, I believe, make the diagnosis positive.

EVENTRATION OF THE DIAPHRAGM*

BY HENRY J. WALTON, M.D.

BALTIMORE, MARYLAND

THE condition known as eventration of the diaphragm was first described by J. L. Petit in 1774, but it was not until 1829 that Cruveilhier used the word "eventration" in differentiating this unusual malformation from hernia of the diaphragm. Although the term is misleading, it has now been generally adopted and represents a condition in which one dome of the diaphragm is stretched out and elevated high into the thoracic cavity so that the abdominal viscera immediately beneath are contained within the thorax; while in diaphragmatic hernia, the abdominal viscera are displaced into the thoracic cavity through a normal or pathological orifice in the diaphragm.

Eventration of the diaphragm does not necessarily produce symptoms. When these do occur, they are usually referred either to the cardio-pulmonary, or digestive organs. It is found four times more frequently in men than in women. Most observers believe it to be of congenital origin, which is substantiated by the fact that it has been found in a number of infants, and is usually associated with other congenital defects. It nearly always involves the left side of the diaphragm, the top of the dome often reaching as high as the second or third interspace anteriorly. The viscera in ectopia are usually the stomach, colon, small intestines, liver, spleen and kidney. Only 6 cases of eventration on the right side have ever been reported. When it does occur on the right side, there are no gastro-colonic or cardiac signs, the liver being the organ which fills up the abdominal projection.

Eventration was formerly an autopsy discovery just as it is now a roentgenographic discovery. It is mainly on account of the value of the roentgen ray in making the diagnosis of eventration of the diaphragm, that this subject is being presented, and my remarks will be confined chiefly to a consideration of the roentgenographic signs which make it possible of differentiation from other conditions.

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* Read at the Fifth Annual Meeting, Eastern Section, American Roentgen Ray Society, Atlantic City, N. J., Jan. 24–26, 1924.

The first case diagnosed during the life of the patient, was reported by Glaser in 1901; this patient was supposed to have had a diaphragmatic hernia, but at operation, eventration was found. The patient recovered.

The first account that I have been able to find of the use of the roentgen ray in the diagnosis of this condition, was in 1900 when Hirsch diagnosed a case as hernia of the diaphragm. In 1901 Struppler reported a case of hernia of the diaphragm based on roentgen findings. Both of these cases, however, proved subsequently to be eventration. Considering the difficulty experienced even now with all modern methods of diagnosis in differentiating eventration and hernia, due credit should be given to these men in spite of their misinterpretations.

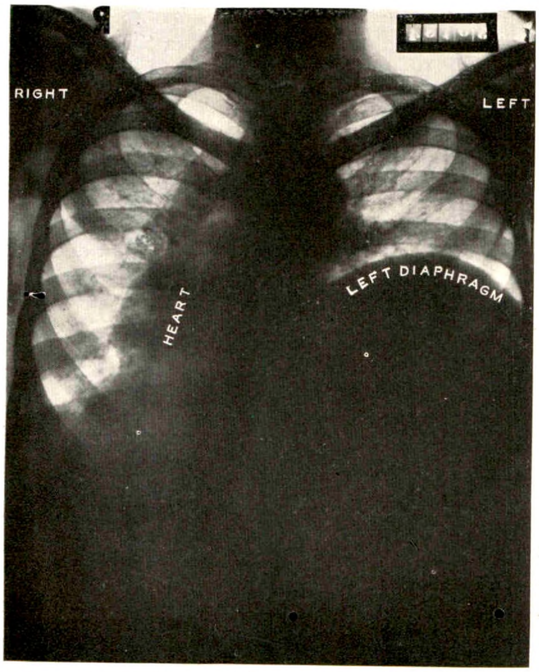

Fig. 1.

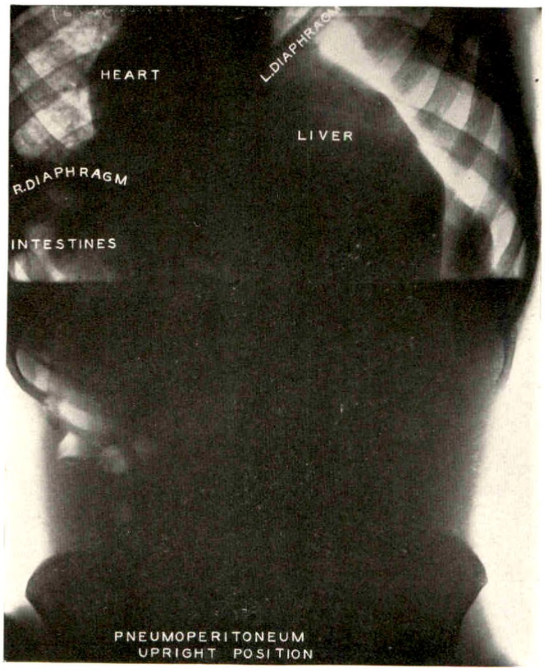

Fig. 2.

Bergmann in 1913 in his excellent review of the literature of eventration of the diaphragm found reports of only 22 certain cases and 5 probable cases of eventration; several of these were diagnosed by means of the roentgen ray. During the past ten years there have been more authentic cases of eventration reported than in the previous one hundred and thirty-nine years, when Petit reported the first case in 1774. Nearly all recent writers mention the roentgen ray as an aid in arriving at the correct diagnosis.

In the differential diagnosis, the most common conditions which give similar roentgen shadows, are pleural effusion, pneumothorax and hernia of the diaphragm. The two former can very readily be eliminated by the use of the barium meal and enema. If the stomach or colon is located in the thorax, the only quesion to decide is whether they are above or below the diaphragm, hence the diagnosis narrows itself down to a question of eventration and hernia.

Quite a number of roentgenographic signs and observations have been brought forward by various writers in recent years, but only those which seem most important, and which should always be looked for will be mentioned, namely:

(1) The high position of the diaphragmatic arch.

(2) The regular contour of the arched line.

(3) Excursion usually present, but limited.

(4) Paradoxical movements on the affected side.

(5) Mediastinal excursion, from the affected side toward the sound side during inspiration.

(6) Displacement of the heart to the right.

(7) Distinguishing line between the diaphragm and viscera below.

(8) Pneumoperitoneum.

In eventration there is always present the typical curved line of the dome of the diaphragm, which lies high in the thoracic cavity, but this is not sufficient for diagnosis as the same condition is sometimes seen in hernia, where a dilated stomach or colon gives a similar appearance. In hernia the contour of the arch is usually irregular and somewhat nodular.

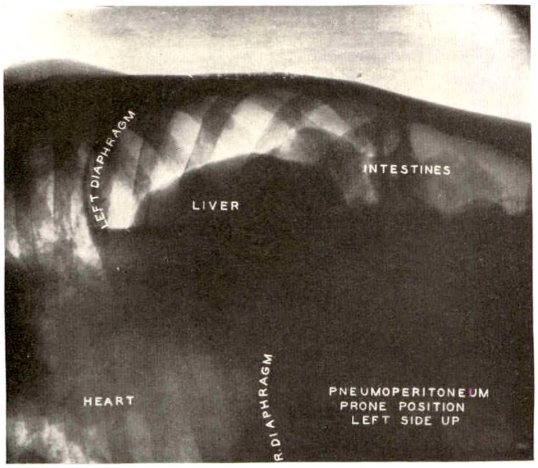

Fig. 3.

In eventration respiratory excursion is nearly always present, but the movements are limited on the affected side. Paradoxical movements (inspiratory ascent and expiratory descent) of the affected side of the diaphragm have been observed in eventration, but this condition has been noted more often in hernia. Mediastinal excursion to the right side during inspiration, due to a greater degree of intrapleural pressure on the sound side, is a sign which has been observed and should be looked for, although its value in differentiating eventration from other abnormal conditions of the left side of the thorax is questionable.

The only pathognomonic roentgen sign of eventration of the diaphragm is a distinguishable separation of the arched line of the dome of the diaphragm from the viscera below. This can best be accomplished by the introduction of air into the peritoneal cavity. The patient may be examined in either the upright or lateral position. In eventration the abdominal viscera will drop away from the diaphragm, while in hernia the dome of the diaphragm cannot be isolated from the hernia above. It is only necessary to introduce a small amount of air in order to make this test. In cases of hernia, care must be exercised not to overdistend the abdomen on account of the danger of producing a strangulation. If fluid is present in the abdominal cavity, this should be withdrawn before the introduction of air.

CASE REPORT

The patient, a colored laborer, aged forty-nine, entered the University Hospital September 1, 1923, complaining of gastric symptoms.

Family History. Negative.

Past History. Unimportant, except he stated that he had a chancre twenty years ago, for which he was treated and cured. No evidence of secondary lesions. Patient stated he was told fifteen years ago that his heart was on the right side.

Present illness began eighteen months ago when he first noticed swelling of his feet and ankles. The legs, thighs, scrotum, and abdomen gradually became involved. Ascites became so great that a paracentesis was performed and three quarts of a clear, straw-colored fluid were withdrawn, after which the patient's condition improved and he went back to work. Several months elapsed before the edema reappeared and with it abdominal symptoms returned, such as tightness and fullness after eating. He complained of no pain. His appetite remained good and there was very little loss of strength. He had been constipated for the past six months.

Physical examination showed an apparently undernourished man of medium stature, face slightly drawn, skin loose, eye balls prominent; pupils equal and reacted to light and accommodation: teeth in poor condition; tongue dry and furrowed; thyroid not enlarged.

Chest asymmetrical, left side more prominent than the right. Respirations not embarrassed. Percussion showed impairment on the left side below the 4th rib anteriorly, and the 7th rib posteriorly. Below this area, breath sounds were not audible, but above they were loud, clear, and vesicular. Percussion of the cardiac area showed a vertical border on the left side 1¾ in. from the mid-sternal line, the right border taking a diagonal course, outward and downward, its most lateral point being in the 5th interspace at the nipple line. Cardiac area did not change position upon turning patient from side to side. The heart beat was quite distinct just below the right nipple, at which point a sharp impulse could be felt. Pulse regular; no palpitation.

The abdomen was distended, and was most prominent in the left hypochondriac region. The thoracico-epigastric veins were distended. The percussion note was tympanitic in the upper right abdomen. There was no palpable mass in the right hypochondriac region but a resisting mass was felt in the left hypochondrium.

Genito-urinary Tract. There was increased frequency of urination, no pain and no hematuria. The urine was dark in color, and there was a trace of albumin.

Blood examination, negative.

Wassermann, 100 per cent positive.

The deep reflexes were sluggish. There was no ankle clonus and no Babinski sign, and no sensory disturbances. Rhomberg negative. All coordination tests were good.

Roentgen examination showed a very high left side of the diaphragm, the top of the dome being on a level with the second interspace anteriorly. The diaphragm was freely movable. The left costophrenic angle was clear. The outline of the right side of the diaphragm was irregular. The costophrenic angle did not clear on deep inspiration and excursion of the right side was limited, due probably to adhesions following some old inflammatory process at the right base. There was evidence of considerable pleural thickening.

Both lung fields were clear. There was considerable increase in density in the root and bronchial shadows, especially on the right side. Several small calcified lymph nodes were present in the right root region.

The heart was transposed, its left border being about 1 in. to the left of the spine, its right border about 3 in. to the right of the spine. The mediastinal contents were also displaced to the right. The aorta was moderately dilated.

The opaque meal passed normally down the esophagus into a medium sized stomach, the esophagus being displaced slightly to the right. The cardiac end of the stomach was in the left hypochondrium, and the greater curvature on a level with the umbilicus. The pylorus was to the right of the second lumbar vertebra. The stomach and cap were normal in outline.

The roentgen examination after a pneumoperitoneum, following the withdrawal of fluid from the abdominal cavity, showed the left diaphragmatic arch in the same position as previously reported, with a large airspace between the diaphragm and the abdominal viscera. Below the air was seen a large dense mass simulating the liver, and superimposed on this shadow were two smaller and fainter shadows, one of which had the appearance of a kidney. The patient would not consent to a cystoscopic examination.

Immediately below the right side of the diaphragm were coils of intestines partially filled with air. No shadow of the liver or other mass was seen below the right side of the diaphragm.

The following is a summary of the roentgen signs present in this case:

(1) The high, smooth contour of the left dome of the diaphragm.

(2) Free excursion of the diaphragm.

(3) Transposition of the heart.

(4) Isolation of the arched line of the diaphragm after pneumoperitoneum.

(5) Associated congenital defect. (Transposition of liver.)

Signs not observed:

(1) Paradoxic movements.

(2) Excursion of mediastinum to right during inspiration.

Conclusions based upon the roentgen examination:

(1) Eventration of the left side of the diaphragm
(2) Dextrocardia
(3) Transposition of the liver

Eventration of the diaphragm has always been considered a rare condition and has seldom been discovered in life except by the aid of the roentgen ray. It is quite probable that its occurrence is far more frequent than has heretofore been supposed, and the possibility of its existence must always be borne in mind whenever the diaphragm is situated higher than normal, especially if this is accompanied by a displacement of the heart to the right.

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REPORT OF A CASE OF TRAUMATIC HERNIA OF THE DIAPHRAGM*

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A REVIEW of the literature of hernia of the diaphragm is hardly necessary for the purposes of this case report. There have been many cases reported since the advent of the roentgen ray and, considering the disparity of reports on this condition prior to 1913, it would appear that the clinical evidence was either insufficient, in a large proportion of cases, to call attention to the possibility of the existence of a hernia, or the clinician had not been sufficiently on the alert.

Giffin, in 1913, reported upwards of 690 cases recorded in the literature up to that time, but of all these cases only 15 had been diagnosed, the others having been found at necropsy.

Since then a large number of cases have been reported, but in many instances the findings were incident to a study of the gastrointestinal tract by the roentgenologist.

Although few conclusions can be drawn from 1 case, nevertheless the conditions surrounding 1 case may be sufficient to emphasize the necessity for eternal vigilance. Hence this report.

The patient, a male, aged forty-seven, occupation trucker, was admitted to the Surgical Service of the Frankford Hospital on September 16, 1921, following an automobile accident, in which he was squeezed between a building and the wheels of a truck. At that time he suffered a fracture of the left femur on a level with the lesser trochanter, and contusions of the left leg and abdomen. No symptoms referable to the chest or ribs were noted at this time, except that the patient complained of pain in the upper left quadrant of the abdomen. No request for chest or abdominal roentgenograms was made at this time. The previous history was irrelevant.

Nineteen days after admission the patient was transferred to the Municipal Hospital with scarlet fever.

On May 17, 1923, almost two years after the accident, the patient was referred to me by Dr. John Raftery, his family physician, to determine the presence of any pleuritic disturbances arising, possibly, from old fractured ribs at the time of the accident. The patient complained of indefinite pains in the chest and abdomen, mainly on the left side.

Roentgenograms were made, but no roentgenoscopic study was made at this time. The roentgenograms revealed a peculiar lack of outline of the normal diaphragmatic dome on the left side and a few rather heavy lines suggestive of pleuritic adhesions with some pulmonary thickening.

I requested the patient's return for examination by roentgenoscope and opaque meal, at which time we found a hernial opening of large caliber in the left diaphragm through which passed the stomach, portions of the small intestines and colon.

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* Read at the Fifth Annual Meeting, Eastern Section, American Roentgen Ray Society, Atlantic City, N. J., Jan. 24–26, 1924.

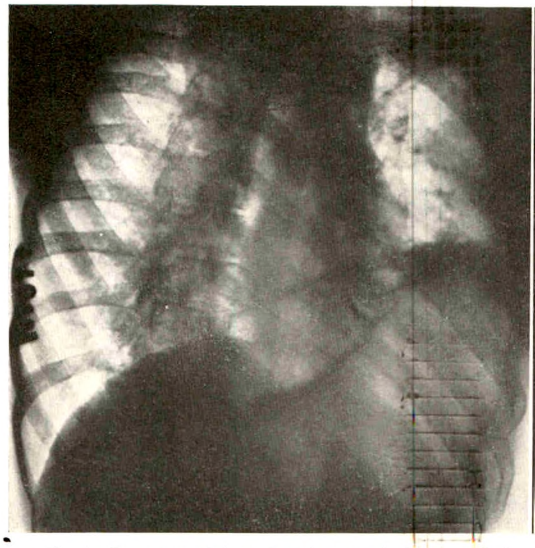

Fig. 1. P. A. Prone position showing pathology at left base with irregular double lines of diaphragm shadow.

On May 27, ten days later, the patient was admitted to Frankford Hospital.

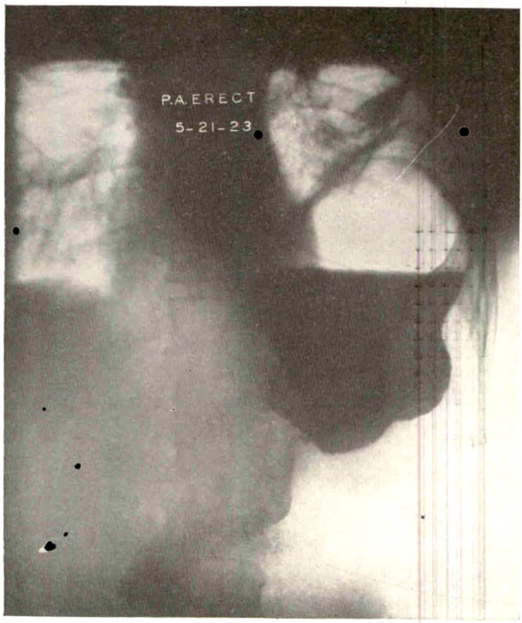

Fig. 3. P. A. Erect with barium-filled stomach.

The history states that since the accident two years previously, he had suffered more or less from pains in his left chest, with exacerbations in the last three weeks. He had dyspnea; there was some nausea, but no vomiting. He complained of a sense of epigastric fulness, and gurgling in the left chest with slight palpitation at times.

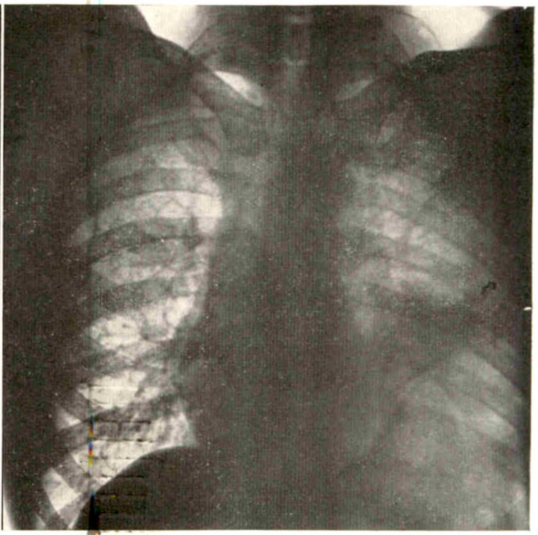

Fig. 2. Oblique prone showing wide posterior gap in left diaphragm.

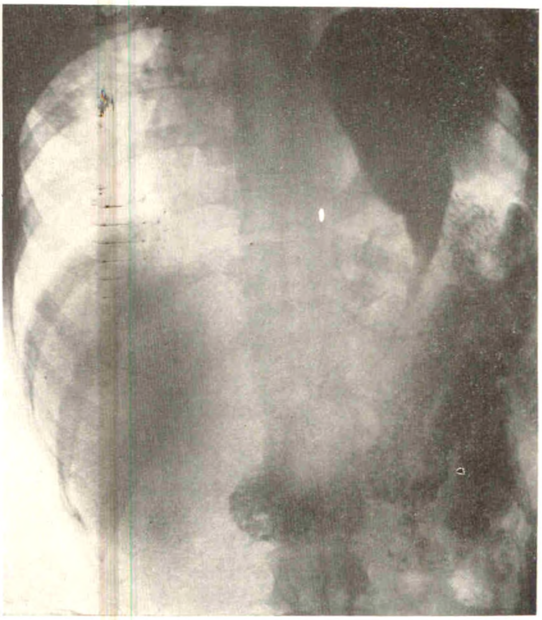

Fig. 4. P. A. Prone with barium-filled stomach passing through rent in diaphragm.

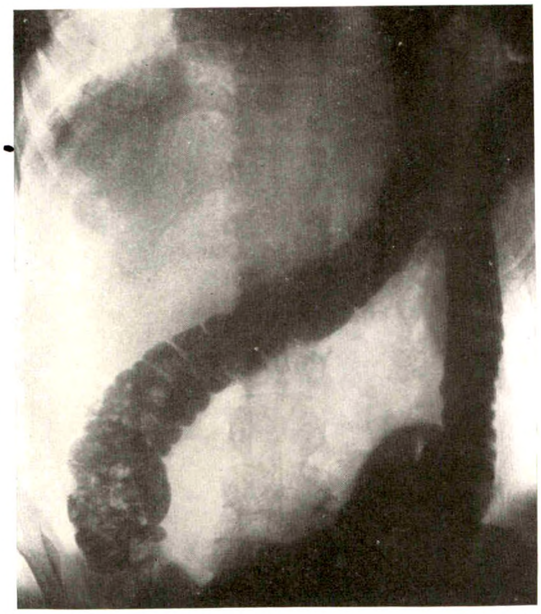

FIG. 5. Injected colon passing through rent in diaphragm.

Physical Examination. The heart sounds were heard best near the sternal border on the left side, and faintly to the right of the sternum; not heard at all in the left nipple area. Gurgling sounds were heard in the normal heart area. The heart sounds were normal as to rhythm, etc.

The lungs showed normal resonance on the right side. The left side presented a tympanitic area over the normal heart area with slight impairment at the base.

The abdomen was negative.

The day after admission the patient was operated upon. The following description of the operation and findings are given through the courtesy of Dr. C. F. Nassau and Dr. L. D. Englerth, the surgeons:

"The patient was anesthetized with intratracheal ether. An incision was made in the left chest and the pleural cavity was entered. Protruding through the diaphragm were found the stomach, omentum, portions of the small intestines and a portion of the colon. By means of packs, these organs were replaced in the abdomen and a rent of about 5 in. long was repaired. The tear passed from behind in the left crux of the diaphragm, forward and across. No sac was present. The edges were perfectly healed, the pleura and peritoneum being healed over the edges. A needle was placed in the left pleural cavity and the chest closed tightly. The suction apparatus was applied through the needle at the same time that extra positive pressure was made through the intratracheal apparatus, resulting in the almost complete return of the collapsed

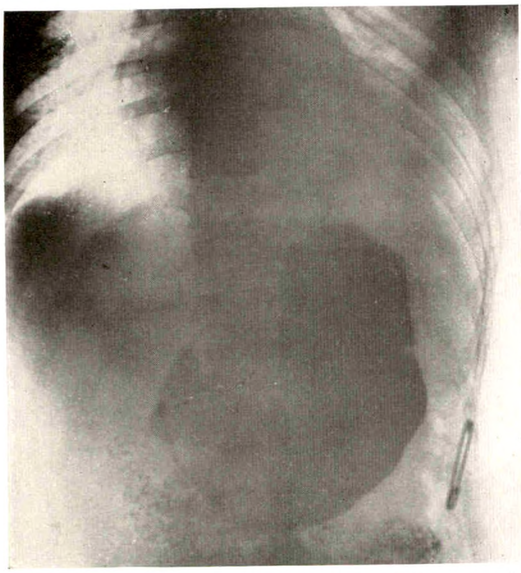

FIG. 6. Postoperative erect with stomach in normal position. Some exudative pathology still present at left base.

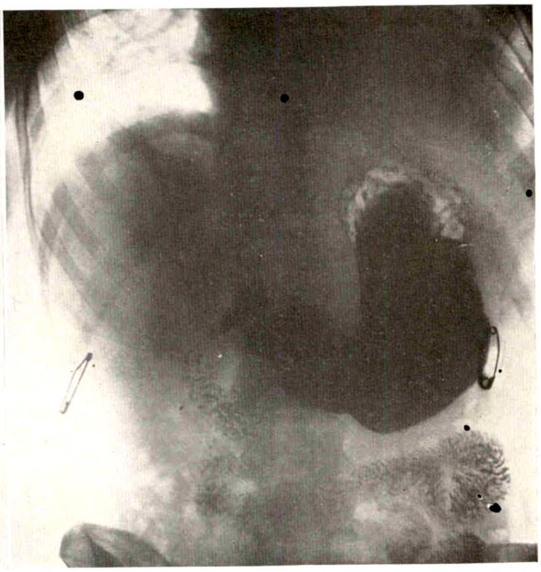

FIG. 7. Postoperative. Prone with stomach retaining its normal position.

lung to a normal position, without a pneumothorax persisting."

The patient made an uneventful recovery and prior to discharge three weeks after admission was again roentgenographed. The diaphragm on the left side was functioning normally and presented a normal outline. The pleura was somewhat thickened and contained a small quantity of fluid but was otherwise negative.

In conclusion let me call attention to a few lessons this one case has taught me.

1. The possibility of the existence of a traumatic hernia without marked clinical evidence.

2. The necessity for the roentgenologist to carry his studies to a satisfactory conclusion, approaching every examination with an absolutely open mind, uninfluenced by history or clinical suggestions. If the diagnosis of diaphragmatic hernia, whether congenital or acquired, as well as many other conditions, is dependent on the roentgen ray, it behooves the roentgenologist to extend his field of usefulness by not limiting his examinations to too narrow or limited areas.

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PALLIATIVE DOSES OF ROENTGEN RAY IN ADVANCED CANCER*

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THE physical basis of deep roentgen therapy is firmly established, for not only can electric currents be induced to activate a roentgen-ray bulb to produce a radiation of wave-lengths approaching that of the gamma ray of radium, but the comparative effectiveness of these rays on the surface and in the depths has been determined by the spectrometers and the iontoquantimeters. The properties of filters are so well known that almost any desirable hardness of the primary beam can be obtained. The effects of scattered and secondary radiation on the depth dose quotient have been determined by actual measurements in phantoms of wax or water. From a mass of experimental data physicists in this country and abroad have plotted charts by which we can figure our doses as indicated in deep therapy.

From the clinical point of view the problem of the radio-therapy of neoplasms rests on far less certain grounds. We have as therapists no exact standards by which our effects can be predicated, calculated or measured. The only criterion by which we can judge any radiation we are using is by its biologic effect on the patient.

By clinical experience the biologic effects of hard and soft rays on the human body have been found out. We know fairly exactly at what point an erythema arises in the skin. We know where more violent or more destructive changes will be produced. We have a rough idea of the susceptibilities of the various normal tissues to radiation. But in the treatment of a patient with cancer we are confronted with a special individual problem. The better our knowledge of the pathologic anatomy of the patient's disease, and the more exact our control of the physical factors involved, the more scientifically exact will be our therapy.

The idea of intensive roentgen-ray dosimetry on the unit of the skin erythema dose was conceived by German roentgenologists (Seitz and Wintz, Krönig and Friedrich). They have said that there is little individual variation in susceptibility of normal skin to roentgen ray—the limit of variation being set at 15 per cent—so that the amount of radiation needed to produce an erythema can be used as a standard, for obviously the limit of tolerance of skin is the limit of intensity by which a subcutaneous tumor can be radiated.

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Our experience to date does not confirm the observation of others that a dose of roentgen ray which in one patient produces a mild erythema may in a second produce a severe reddening, and in a third vesication. We have found nothing that can be properly called an idiosyncracy to roentgen ray; nor can we fully agree that the erythema is definable in as narrow limits as others have determined it. We have observed our skin doses through a galvano-iontoquantimeter in such a way that the output of the roentgen-ray tube during a treatment was constantly measured. These observations will be noted in another report.

In the same way that a skin unit dose has been set up there have been established by continental roentgenologists the so-called "cancer dose," "sarcoma dose," "castration dose," etc., all figured in percentage of an erythema. This conception certainly gives us a technique with which to begin our therapy, but whether or not these values have the fixity set for them there is at present no irrefutable evidence by which to decide.

Recently there have appeared in the literature accounts of damage to normal tissues by doses theoretically safe, indicating that there is a varying susceptibility of normal deep-seated tissues to doses under quite absolute physical control. The first damages noted were those to the blood. There have appeared a great number of reports on this subject. Fischer[1] cites some personal cases of intestinal damage by roentgen ray, and gives a critical review of the German literature to date. Some of the damages noted were caused by raying through a single port with a single erythema dose; others were due to errors of technique. The damage to the pleura and lung incident to the radiation of breast cancer was cited by Groover.[2] The possibility of producing destruction of the suprarenal in radiation of gastric cancer has been mentioned by Holfelder. The occurrence of rectal and bladder fistulas in the treatment of cancer of the cervix both by radium and roentgen ray is both well known and much feared. Late skin effects of *Super-roentgenization* have been described by Seitz.

If there is such a variation in susceptibility of normal tissues to radiation externally applied as these few examples seem to indicate, it can logically be assumed that there is the same variation in the reactivity of neoplasms. The very nature of new growths seems to forestall any standardization of doses for tumors. Clinical observation has repeatedly shown that two tumors of the same histologic structure may exhibit an entirely different life history of malignancy. Certainly there remains no doubt about the different reactivity of epidermoid and adenocarcinoma to external radiation. Indications seem to point to the fact that adenocarcinomata originating in the breast, in the intestine and in the uterus are to be regarded as three distinct diseases. That adenocarcinoma, relatively a susceptible tumor, can be highly resistant under some conditions can be attested by three personal cases (breast) rayed with from three to five erythema doses through copper or aluminum in none of which did healing take place. One case of fungating epidermoid cancer, metastatic in the groin, was given seven erythema doses divided, through copper, with no marked improvement.

There seem to be no well-marked boundaries in the microscopic structure of tumors. One heterogeneous group of cell structures grades off into another. For this reason attempts to standardize tumor-doses on the susceptibility of some type-tumor have been unsuccessful. It seems, therefore, that the doses of roentgen ray necessary to destroy cancer, which is in itself a very varying entity in malignancy, are definable only in similarly wide limits.

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[1] Fischer, Bernh. Uber Bestrahlungsnekrosen des Darmes. (Mitt 3 Abb). *Strahlentherapie*, 1922, xiii, 333.

[2] Groover, Thos. A. Intrathoracic changes following roentgen treatment of breast carcinoma. Am. J. Roentgenol., 1923, x, 471.

The uniform susceptibility of sarcoma to uniform doses of roentgen ray stands on just as uncertain a foundation. The possibilities for variation in sarcoma structure and malignancy—even though there is no definite fixed relation between them—seem as great as in the cases of epithelial tumors, so that sarcomas, too, may exhibit widely varying biologic phenomena. Sarcoma, as is well known, manifests itself as widely varying clinical entities. Here also it would seem that the dose depends on the possibilities of combination of histologic structure, on the stage of development of the tumor, as well as on the little understood tumor host himself.

In their collected report, Werner and Grode[1] emphasize particularly that the capability of reaction of tumor structure to radiation shows great variation, and that carcinoma and sarcoma doses represent only the minimal values. The same view is held by other German roentgenologists, among whom may be mentioned Holtzknecht, Holfelder, Eckelt, and others. Strauss[2] insists that the conception of uniform susceptibility of cancer to radiation is untenable. The same view has for years been held in this country by Wood and by Ewing, most effectively expressed by the latter in the Mutter Lecture "An Analysis of Radiation Therapy in Cancer."

The peculiarly great susceptibility of embryonal tumors to radiation has long been established. Tumors of poorly differentiated, rapidly growing cells, rich in blood vessels, have for years been one of the most satisfactory fields of radiotherapy. As a rule tumors of lymphatic origin are also favorably influenced. Yet some microscopically undifferentiated tumors (teratomas, for example) may show a marked resistance to radiation, while others of a more adult structure may show a great susceptibility. Similarly, not all lymphosarcomas do well under radiation. Yet it does not seem that differences in makeup alone of tumors account for the differences in their radiosensitiveness.

It seems fairly well demonstrated clinically that there is no uniform destructive dose of roentgen ray for all cancer cells. That the effect we want to get is a direct destructive, killing action on cancer cells alone has been contested by many observers. That a homogeneous killing dose is the desideratum is denied on many sides. But assuming that these are the optimum criteria, there is at present no agreement whether this dose shall be given best in one or in several sittings, or, if a repetition is indicated, after what interval it should be given.

There are many recent statistics which show that with increased intensity of radiation an increased percentage of recurrence is noted. Werner, on a basis of his observation of 8000 cases of malignant disease treated at the Heidelberger Krebsinstitut, warns against treating tumors too vigorously, and especially with hard rays.

Arguments for and against single intensive doses are manifold.

Opitz,[3] in a careful survey of cases treated by Perthes, Ansschutz, Krönig and himself, made the observation that the best curative results were obtained by repeated radiation in which the socalled "cancer dose" of deep therapy was not obtained. Certainly there remains no doubt that proven cancer has been repeatedly cured by roentgen-ray doses of far less intensity (9-in. spark gaps, for example) than those now in vogue in deep therapy.

Halberstadter, Blumenthals, Theilhaber, M. Fraenkel, Caspari, Ribbert and others have suspected that the results of radiation do not depend on an actual destruction of cancer cells, but on the strengthening and stimulation of the normal surrounding structures in addition, in such a way that the cancer cells are conquered and their proliferation prevented. Ewing (loc. cit.) says, "From the study of much material from operation and autopsy in cases treated by deep radiation I have become convinced that the clinical results are not usually due to the direct killing action of the radiation, but are brought about indirectly, and mainly by interference with the circulation, capillary, venous, arterial and lymphatic. This conclusion is in accordance with the rule of pathology that acute necrosis of tissue cells generally means interference with the blood supply. . . . On the other hand when one proceeds in deep therapy on the theory that therapeutic results depend not only on injury to tumor cells but also on defense reactions of the body and the tissues, the immediate results seen seem to be most equally striking, and the end-results often more satisfactory, and the treatment is conducted with less damage and danger to the patient."

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[1] WERNER and GRODE. *Ergebn. d. Chir, u. Orthop.*, Oct., 1921, xiv, 222.

[2] Strauss, O. Modern cancer treatment. *Deut. Med. Wchnschr.*, 1921, xlvii, 597.

[3] OPITZ, E. Principles of radio therapy of carcinomata, especially of uterine and mammary carcinoma. AM. J. ROENTGENOL., 1923, x, 312.

It would be ideal to find a radiation dose fatal to each case of tumor which could exert on the surrounding normal cells a stimulating effect, but unfortunately the cells of the various tissues have not this degree of differentiation of susceptibility, and the conception of such a dose must for the time being remain an ideal. The margin of safety between damage to tumor cells and to normal cells is in reality an extremely narrow one.

Many observers have called attention to the clinical fact that patients with advanced cancer do poorly under any form of therapy. The primary breast tumor, with wide-spread metastases, has in our experience as in that of others, manifested a peculiar hyper resistance to roentgen-ray doses while in cases of the same type of tumor with less involvement satisfactory regression has been produced. It may be that in this type of disease the tumor has taken on new growth characteristics of such a type that its biologic reactivity to radiation is different, or it may be that the resistance or immunity of the host to tumor invasion is decreased. At present both views are without absolute confirmation.

Similarly, most roentgenologists agree that cachectic patients are extremely poor subjects for radiation therapy. Not only are they not able to stand a cycle of intensive treatment, but they are regarded as approaching the natural fatal termination of their disease. Their reserve of bodily functional capacity is at a low ebb; their power of healing and regeneration is very slight. To decrease their nutrition by postradiation nausea, to produce hemorrhage into the tumor, to destroy their blood elements, to add to their pain, or to add to the toxic effect already present, will hasten the approaching end.

This advanced, cachectic, hopeless group of primary and recurrent cancer is the basis of this report. All—100 per cent—were inoperable. All were poor risks for any form of intensive or radical therapy. Nothing approaching a cure could be hoped for in any case.

In the following case history reports we are frank to admit that we have selected favorable cases. But here we are dealing with a vague term, especially since the prognosis of every patient is so bad. We are not citing a group of cases large enough to enable us to draw any conclusions. No result has stood the test of the accepted four year interval. The doses used are mentioned only as an indication of what may be accomplished, and are not advanced as a technique to follow in earlier and more favorable cases.

CASE REPORTS

Case I. Male, aged forty-seven. Attention first directed to trouble in antrum in February, 1923, when a molar tooth became loose. Patient had various kinds of treatment—no surgery nor radiation until June when he received both radium and roentgen ray at another hospital, the last treatment being in September. Biopsy was made which showed round-cell sarcoma.

On October, 15, 1923, he was admitted to this hospital, with severe pain in left face and very poor general condition. Examination showed marked prominence of the left eye with complete obliteration of the infra-orbital hollow and marked reddish blue discoloration of the whole region. Patient could not close his left eye. The antrum was protuberant and the left nares blocked.

Roentgen examination showed considerable destruction of the malar bone and a marked haziness about the frontal and ethmoidal regions. A diagnosis of malignancy was made. Examination of the chest showed probable metastases.

The usual laboratory tests were negative. Ophthalmoscopic examination showed a choked disk, with enormous dilatation of the vessels from pressure behind. The mass in the orbit prevented further examination. The condition of the patient was regarded as hopeless.

Patient was treated with roentgen ray on October 27 after which the pain was markedly less, and on November 22 he showed marked improvement and no pain. The treated area was apparently normal. The patient was well four months after treatment was instituted. The tumor was probably a lymphosarcoma.

The technique is two half-skin doses at one month interval. No attempt was made at crossfire.

Case II. Female, aged forty-two. Left breast was amputated two years ago for a tumor of unknown duration. Recurrence in the scar and in the other breast about a year later. Backache for about a year. Patient bedridden.

Patient was admitted to hospital on January 22, 1923; was markedly emaciated and complained of severe pain in the region of the lumbar spine and down the thigh. There were multiple skin nodes along operative incision, and there was involvement of the right breast forming a tumor 1½ × 2 in. There was also involvement of the supraclavicular nodes on both sides.

Roentgen examination showed metastases to the outer third of the left clavicle, both lungs, head and neck of the left humerus, the entire glenoid region of the scapula, with destruction of the fourth and fifth lumbar vertebrae, the sacroiliac joints and ischium.

The microscopic report was adenocarcinoma, and the condition regarded as hopeless.

Treatment was instituted on January 31, 1923, and on December 1 the patient was clinically well. The technique used was: Skin doses over the right hip and sacrum. Sub-erythemas over the rest of the pelvis and other involved bones using 200 kv. and copper filter. Chest treated with fractional doses using 9 in. back-up and 3 mm. Al. filter. There was complete disappearance of all nodes; the right breast was normal, except for a sclerotic mass 1 in. in diameter. The patient weighed 167 lbs.

Case III. Male, aged seventy. Admitted to the clinic February 21, 1923, with diagnosis of carcinoma of the stomach.

About a year ago noticed pain in epigastrium which was aggravated by food, with occasional vomiting; loss of weight, and weakness.

Roentgen examination of the gastrointestinal tract on February 6, 1923, showed a retention of fully two-thirds of the morning barium meal. There was a marked filling defect along the greater curvature and pars media. Examination of the chest showed metastases into the mediastinum. Condition considered hopeless because of the patient's general condition and the extent of involvement of the stomach.

Patient was treated with roentgen ray, and examined again on October 9, 1923, at which time there was no six-hour retention. There was, however, some retention in the conus duodenalis. The pylorus and first portion of the duodenum were displaced unduly to the left. The filling defect along the greater curvature noted in previous examination was not outlined at this examination. Metastases in the chest were increasing, however.

January, 1924, the patient is symptom-free. Three erythema doses were given at fourteen-day intervals over the anterior abdominal wall, covering the region of the stomach; no crossfire.

Case IV. Male, aged sixty-six. Patient admitted August 12 as an acute surgical emergency with a diagnosis of intestinal obstruction. Complained of intermittent hematuria for about a year and a half.

Exploration of the abdomen revealed a mass in the region of the right kidney, about 7 in. long and 5 in. wide, which was considered inoperable because of adhesions. The growth seemed to have infiltrated all structures in the vicinity. No biopsy was made. Condition considered hopeless.

Patient was referred for roentgen treatment. On October 3, a mass was noted beneath a right rectus incision about 8 × 4 in. There was no evidence of metastases into the chest or bones.

On January 1 there was no evidence of bleeding; the tumor was markedly reduced in size; patient gained in weight and had no complaints.

The treatment consisted of one full dose, through copper, anterior and lateral, and one erythema dose through aluminum, posterior, at weekly intervals. There was no evidence of damage to the spleen or suprarenal.

Case V. Male, aged sixty-seven. Admitted to hospital on September 3, 1923, with diagnosis of carcinoma of the prostate with metastases into the bladder. Patient complained of hematuria for four months, and frequency for six months. Treated medically. Gave up work six weeks ago because of weakness and bleeding.

Cystoscopic examination showed the involvement to be mostly in the right lobe of the prostate, extending toward the rectum. All laboratory tests were normal.

Roentgen examination showed metastases into both lungs, and probable metastasis into the lumbar spine. Condition considered inoperable.

Treatment was instituted on September 5. Hematuria stopped on the third day. There has been occasional slight bleeding since. The technique followed was: Three skin doses anterior over the left, center and right suprapubic regions at three-week intervals, one-half dose over the sacrum, two months later.

Case VI. Male, aged forty-seven. In April, 1922, had appendectomy at another hospital. One week later, a colostomy was done for complete intestinal obstruction. Operation revealed an inoperable carcinoma of the sigmoid.

On admission to this hospital, August 2, 1922, patient was in very poor general condition, emaciated, waxy skin, with a suspicion of jaundice. Examination showed the liver to be 4 cm. below the costal margin, an inguinal colostomy, and edema of the feet and ankles. Condition considered hopeless. All laboratory tests negative.

Roentgen treatment instituted September 26, 1922. In August, 1923, there was bleeding of the rayed colostomy loop. General condition of patient improved steadily. In the middle of November, 1923, there appeared as a late roentgen-ray effect a necrosis of an area 3 × 2 cm., located in the most inferior portion of the lower colostomy loop. Accompanying this was severe pain localized to a segment about 10 cm. in diameter around the colostomy. This necrosis completely healed after two months.

At the present time the skin over the iliac region shows leathery induration. The skin is markedly telangiectatic. Patient has no symptoms referable to carcinoma, and his general condition is fair.

Proctoscopic examination showed stenosis of the gut but no cancer was demonstrable. It may be above the level reached in this examination.

The treatment consisted of four skin doses over the left iliac region in a period of a year. No cross-fire.

Case VII. Male, aged seventeen. Pain in right hip and buttock, paroxysmal, of two years duration. Noticed a swelling over right hip at about the time pain came on. Pain comes on for a week at a time about once a month.

Admitted to another hospital May 3, 1923, at which time there was a tumor 3 in. in diameter fixed to the posterior aspect of the right ilium. At operation the process seemed to be inflammatory, and what appeared to be an abscess cavity was curetted after removing three sections for microscopic study. These all showed small round-cell sarcoma.

Patient was referred to the Philadelphia General Hospital for radiation. Condition was considered hopeless. On admission to this hospital patient was emaciated and in pain. Right leg was held in flexion-adduction with painful motion. The right hip showed a fungating tumor 5 × 4 in., draining bloody pus.

Roentgen examination showed a mottled appearance with areas of rarefaction in the right iliac bone, the chief involvement being along the sacroiliac articulation. Examination of the chest showed probable metastases.

Following the first series of roentgen treatments the pain completely disappeared, and there followed a complete healing of the sinus and disappearance of the tumor in the ilium. On June 27, 1923, three weeks following the completion of treatment, there was no evidence of disease. Roentgen examination of the chest on July 9, 1923, showed no definite evidence of metastases. Patient is considered clinically well.

Treatment consisted of three half-skin doses at weekly intervals; cross-fire; single half-dose over the chest. Repetition of this was given four months later as a prophylactic measure.

The tumor was possibly an endothelioma.

SUMMARY

1. Inasmuch as "erythema," "carcinoma" and "sarcoma" doses have no absolute value, dosimetry on a basis of these is an arbitrary technique.

2. In advanced cancer radiation with the technique of fractional doses applied at intervals has given satisfactory results.

3. The supposition is advanced that in more favorable cases of carcinoma a similar technique may be as effective as more intensive, radical therapy.

STUDIES ON THE PHYSICAL FOUNDATIONS OF ROENTGEN-RAY THERAPY

I

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CLEVELAND, OHIO

SYNOPSIS

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A. INTRODUCTION

WHEN the investigations reported in this paper were undertaken the well-known intensity distribution charts published by Dessauer and Vierheller[1] were used almost exclusively for the control of deep therapy in this country. Besides these charts the only reliable data concerning the physics of deep therapy were those contained in Kroenig and Friedrich's book: "Physikalische und Biologische Grundlagen der Strahlentherapie."[2] As is well known Dessauer's deep curves are quite different from Friedrich's; they give much higher deep intensities for the same working conditions and are also of a very different form. The differences perhaps are accounted for by the difference in the methods of experimentation employed in the two cases, Dessauer and Vierheller having used a photographic method while Friedrich's work was done by means of an ionization chamber. Friedrich's method is to be regarded as the more reliable of the two for biological applications.

On account of these discrepancies we thought it necessary to repeat these measurements using a typical American roentgen-ray transformer. The problems were (1) to find the influence of variations in focal-skin distance, filter and area of field on the surface and the depth doses for certain conditions of radiation, (2) to measure a set of isodoses, and (3) to determine the right combination of filter and focal distance to obtain the maximal deep effect for a fixed surface dose. Furthermore our investigations concerned the determination of the influence on the ionization current of variations in the shape, size and material of small ionization chambers. To determine accurately the roentgen-ray intensities in the so-called "e"-unit we introduced a small ionization chamber of a special material, so that readings were obtained equal to readings in a pure standard air chamber. The results of these latter investigations will be published in Part II of this paper.

Since the undertaking of the present work many investigations on the same subject have been published by Coliez[3] Duane,[4] Erskine,[5] Failla and Quimby,[6] Friedrich and Körner,[7] Glocker, Rothacker and Schönleber,[8] Grossmann,[9] Holfelder,[10] Jaeger and Rump,[11] Solomon,[12] Wintz and Rump[13] and others.[14,15,16,17,18,19,20]

All of these investigators, except Glocker, used Friedrich's ionization method; their results agree well enough for practical purposes, giving for instance values of between 40 and 45 per cent for the relative deep doses under the following conditions: Potential, 200 kv.; current, 5 ma.; filter, 1 mm. Cu. + 1 mm. Al.; focal distance, 50 cm.; area of field, 20 × 20 cm. In general these values are as much as 10 per cent higher than Friedrich's. The variations are mostly due to differences in the definition of the depth of the ionization chamber within the water phantom, as will be discussed later. In his very careful investigations, Glocker[8] has used both a special photographic method and the biological method of Jüngling. His results obtained by the first method agree with those of Friedrich. The values for the deep effect obtained by the biological method, however, are about 20 per cent lower than those obtained by the ionization method.

The values for the deep effects obtained by our experiments are in fairly close agreement with Friedrich's results although the values for the deep dose are usually somewhat lower. The results are also in fair agreement with those obtained by Glocker's biological method, our values for the deep effect lying intermediate between those obtained by Glocker and by Friedrich. Our results are in sharp disagreement with the results obtained by Dessauer.

B. EXPERIMENTAL TECHNIQUE

In principle the method employed is the same as that used by Kroenig and Friedrich.[2] Two photographs of the arrangement are given in Figure 1. Figure 2 shows a diagram of the apparatus. A water phantom 35 × 35 × 35 cm. was used, the rays from the roentgen tube X entering from the side through a celluloid window 2 mm. thick. The electroscope, of the gold leaf type, was mounted on a double carriage on top of the phantom. It was made of lead walls, 7 mm. thick and for further protection was surrounded by a housing of 1½ mm. lead. The volt sensitivity of the electroscope could be regulated by moving the grounded plate P through the micrometer screw S. The capacity of the electroscope could be changed by the introduction of the ceresin condenser C. The brass tube T contained the wire W connecting the ionization chamber electrode with the electroscope;

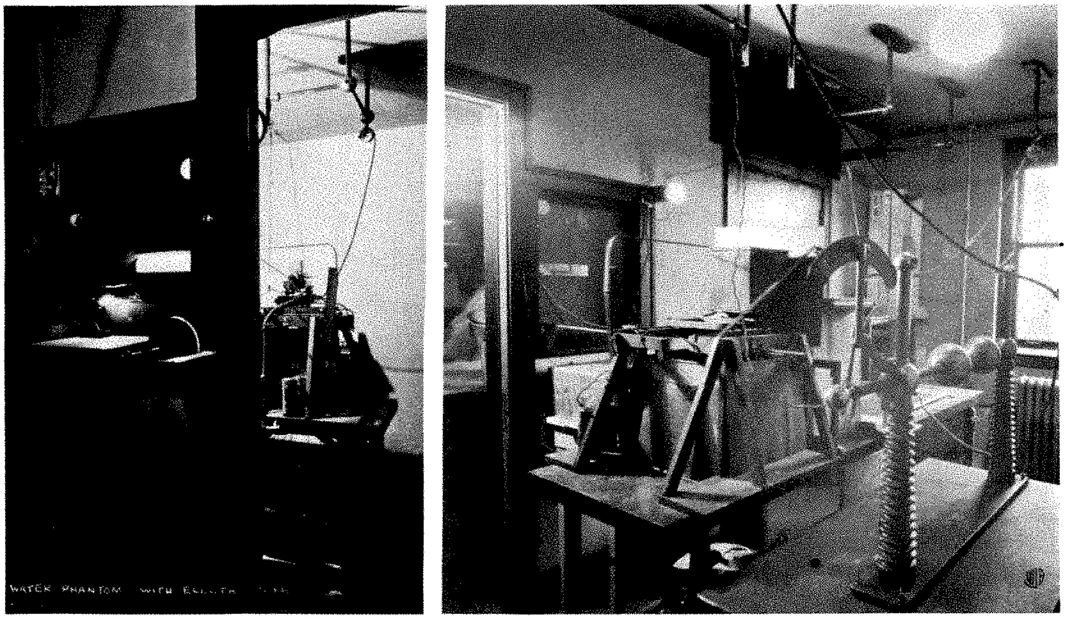


FIG. 1. Arrangement of water phantom and electroscope with observation room.

this tube was filled with ceresin. The main feature of this apparatus is its small capacity (20 cm. without condenser) which allows the use of very small ionization chambers (½ c.c. in volume, or even smaller).

The observer was stationed in a room adjoining that containing the roentgen tube and phantom. From this room he could mechanically move the ionization chamber to any point in a horizontal plane within the phantom, the coordinates of its position being read directly. The shadow of the gold leaf was projected through a window of lead glass to a scale in the observation room where the time of its fall was observed.

The sensitivity of the electroscope was frequently controlled by a battery of 12 volts, this potential being added to the main potential by drawing the switch S_2. The milliammeter used to measure the current through the roentgen tube was also used to read the voltage of this battery, a resistance of 2,400 ohms being introduced in series with it. By this arrangement a reading of 5 ma. indicates a potential of 12 volts and variations in the meter, if they occurred, were automatically compensated by a coincident balancing variation in the calibration of the electroscope.

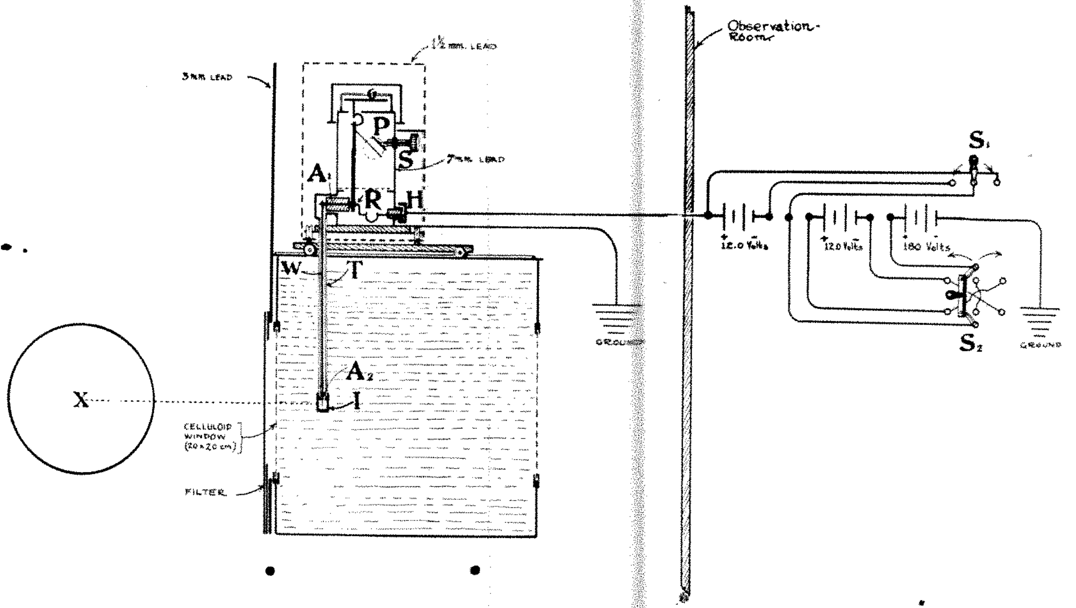


FIG. 2. Diagram of gold leaf electroscope mounted on water phantom.

The electroscope was adjusted so that a change of 12 volts in the potential of the leaf caused it to move over the same number of divisions on the scale over which its fall was observed.

The leakage due to scattering of roentgen rays into the electroscope system, etc., was determined both by placing a lead plate in front of the port of entry, and by surrounding the ionization chamber with lead; no appreciable difference in the scattered intensity was found in the two cases. Even for the faintest radiation the scattered intensity was not more than a few per cent of the total intensity.

Unless otherwise stated the investigations were carried out by means of an ionization chamber made of redmanol (artificial amber) coated inside with a layer of graphite 1/100 mm. in thickness; the chamber was cylindrical in shape (length, 1.06 cm.; diameter, 0.80 cm.) and had a volume of ½ c.c. During our investigations of deep effects, several ionization chambers of different shapes, sizes and materials, were compared, as described in Section D.

We have used a Kelley-Koett mechanically rectified 200 kv. transformer of the type XA for the production of the high potential. The tube employed was the Coolidge deep therapy tube. The roentgen-ray intensity was defined by the current through the tube and by the high potential. The latter was measured by a 12.5 cm. sphere gap, and was kept constant during the work by keeping the primary voltage constant.

the reciprocal, termed "time of treatment." This is given in arbitrary units, using as the unit the time (approximately one hour) which is necessary to produce a light erythema under the following conditions: Potential, 200 kv.; current, 5 ma.; focal distance, 50 cm.; filter, 0.5 mm. Cu. + 1 mm. Al., and area of field, 20 × 20 cm.

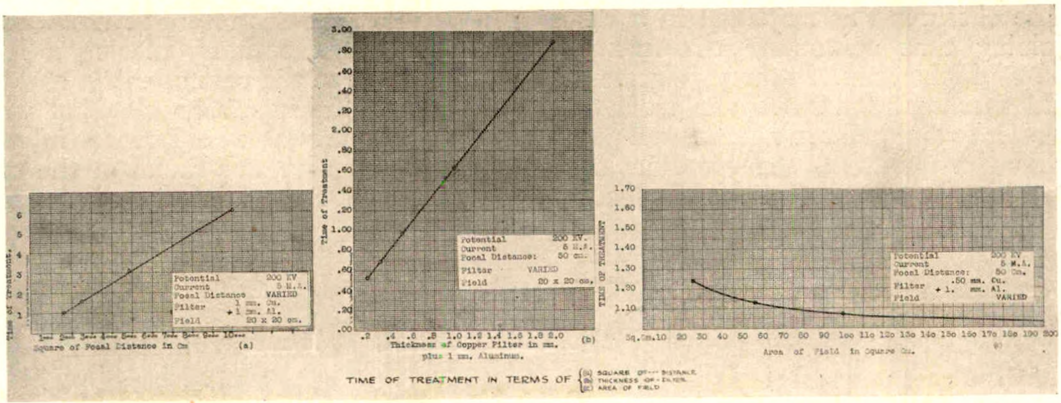
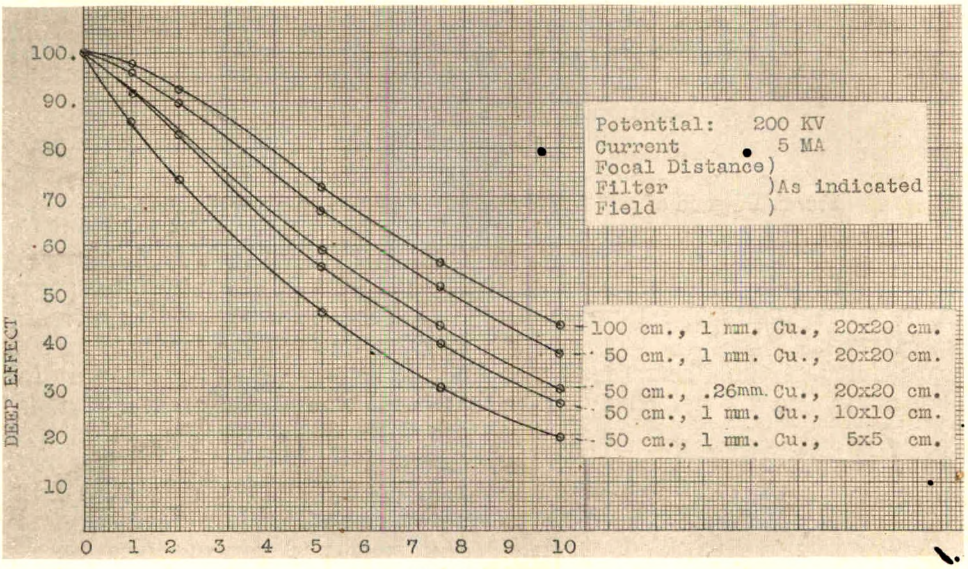


FIG. 3. Curves showing time of treatment in terms of focal distance (a) thickness of filter (b) and area of field (c).

C. THE SURFACE INTENSITY IN TERMS OF FOCAL DISTANCE, THICKNESS OF FILTER AND AREA OF FIELD

The curves in Figure 3 illustrate the relationship of the surface intensity to the focal distance, thickness of filter, and area of field; these curves are all determined at a fixed potential (200 kv.) and a fixed current (5 ma.). Instead of surface intensity the variable used is

Each of the curves in Figure 3 corresponds to the variation of one of the three variables: focal distance (curve a) filter (curve b) and area of field (curve c). The shape of each curve is to such an extent independent of the special values of the two fixed conditions that the curves can be used for practically all combinations of



Depth in cm.

FIG. 4. Typical central deep curves in water.

focal distance, filter and port of entry, which are usually employed in deep therapy.

The procedure to obtain the proper time of radiation under conditions differing from the standard conditions, under which the erythema dose for a given apparatus is known, is to find the ratio between the times necessary to produce an equal effect with (1) the new focal skin distance and the distance used in determining the erythema dose (curve a), (2) the new filter and that used in determining the erythema dose (curve b), (3) the new area of field and that used in determining the erythema dose (curve c). The product of these three ratios gives the factor by which the old erythema-time must be multiplied to give the erythema-time under the new conditions. This may be illustrated by Table I on following page.

D. DETERMINATION OF ISODOSES

In order to ascertain to what extent the shape of the deep curve is dependent upon the size and shape of the ionization chamber, deep curves have been determined under certain fixed conditions, employing different ionization chambers. These were made of redmanol, wood and graphite, and were cylindrical in shape, their dimensions varying from 0.40 cm. in length by 1.80 cm. in diameter to 2.0 cm. in length by 0.56 cm. in diameter. Furthermore the original Friedrich horn ionization chamber (length, 1.7 cm., diamter, 1.5 cm.) was used. The volume of the different chambers varied from ½ c.c. to 3 c.

All these different ionization chambers gave practically the same deep curves for fixed conditions, when the depth was

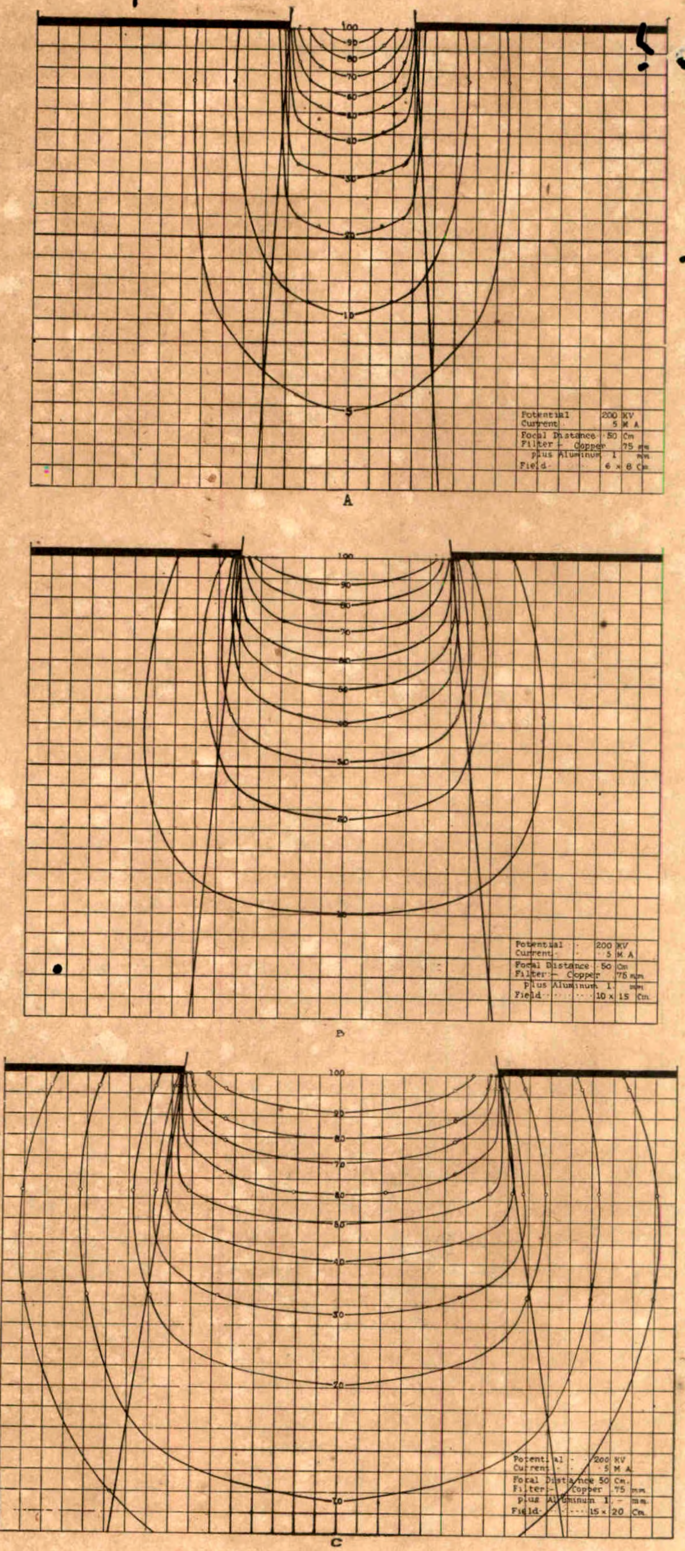


FIG. 5. Intensity distribution curves in water phantom.

TABLE I

	Standard Conditions	New Conditions
Potential	200 kv.	200 kv.
Current	5 ma.	5 ma.
Focal distance	50 cm.	40 cm.
Filter	0.68 mm. Cu. + 1 mm. Al.	0.50 mm. Cu. + 1 mm. Al.
Area of field	14 × 14 cm.	8 × 8 cm.
Erythema time	85 min.	$85\times\frac{1.00}{1.60}\times\frac{1.00}{1.22}\times\frac{1.11}{1.03}=47$ min.

measured from the front surface of each chamber. This indicates that an ionization chamber of finite dimensions records the intensity at its front surface; all deep curves given in this paper are made accordingly. As will be seen from Figure 4, the deep curves especially for large openings are comparatively flat near the surface. The value measured for the surface intensity is therefore nearly independent of the choice of the point of the chamber from which its depth is measured. At the depth of 10 cm., however, the choice of this point is of importance; the value for the deep effect may be found to be as much as 10 per cent too high, when the depth of a chamber of the size of that of Friedrich is measured from its center.

It was noted in Section A that our values for the deep effects are somewhat lower than those obtained by most other investigators who have used the same method. These differences can be accounted for partly by the fact that these investigators have measured the depth of the chamber from its center, whereas according to what was stated above, the depth should be measured from the front surface.

The whole intensity distribution within the water phantom for three typical conditions has been measured. The results are plotted in the type of curves known as Isodoses (Fig. 5).

Isodoses curves corresponding to other working conditions may be constructed with fair accuracy by means of the curves in Figure 6, Section E.

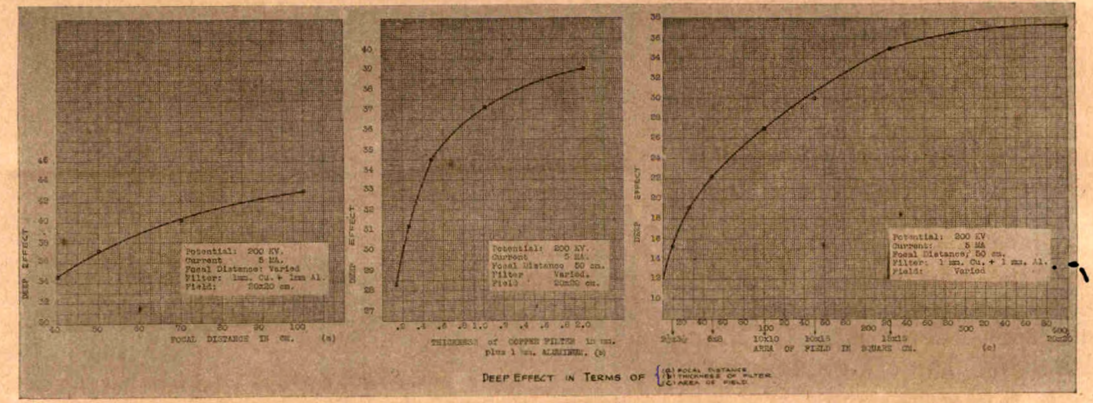


FIG. 6. Curves showing deep effect in terms of focal distance (a) filter (b) and area of field (c).

E. THE DEEP EFFECT IN TERMS OF FOCAL DISTANCE, THICKNESS OF FILTER AND AREA OF FIELD

Each one of the curves in Figure 6 gives the deep effect (ratio of the intensity at 10 cm. depth to the intensity at the surface) in terms of one of the variables, focal distance (curve a, Fig. 6), filter (curve b) and area of field (curve c) for fixed values of the other two.

The deep effect corresponding to an arbitrary set of conditions is determined by the curves a, b, c, using the same procedure as that described in Section C. The following example will serve as an illustration:

TABLE II

	Standard Conditions	New Conditions
Potential	200 kv.	200 kv.
Current	5 ma.	5 ma.
Focal distance	40 cm.	50 cm.
Filter	1 mm. Cu. + 1 mm. Al.	0.75 mm. Cu. + 1 mm. Al.
Area of field	20 × 20 cm.	7½ × 7½ cm.
Deep effect	34.6	$34.6\times\frac{3.70}{3.46}\times\frac{3.62}{3.70}\times\frac{2.30}{3.72}=21.7$

By the procedure described the curves of Figure 6 will give the deep effect with sufficient accuracy for the combinations of distance, filter and opening which are usually employed in deep therapy (area of field should be over 30 sq. cm.).

When the deep effect has been determined as described above, the central deep curves can be constructed by using one of the curves of Figure 4 as a model. Finally the Isodoses curves can be drawn with one of the charts of Figure 5 as a model.

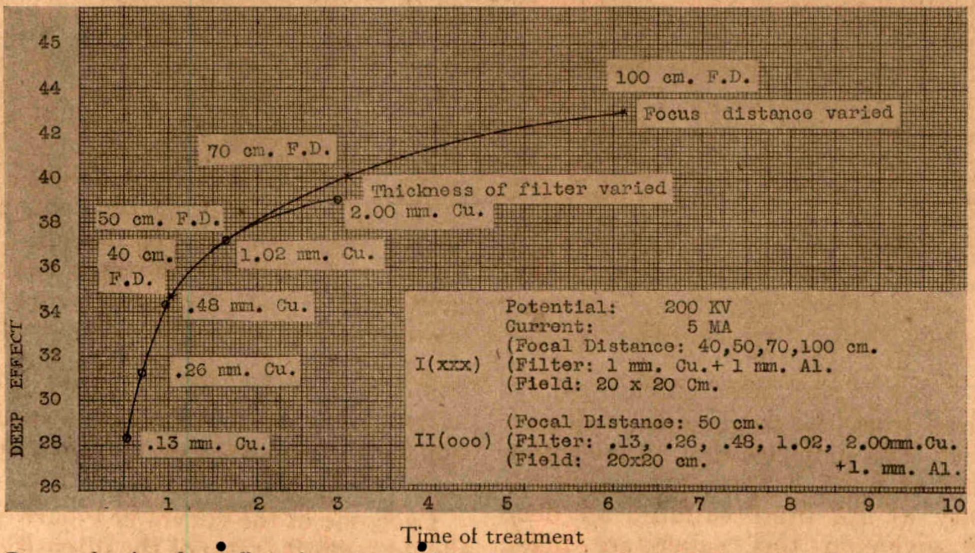


Fig. 7. Curves showing deep effects in terms of time of treatment for variations of focal distance and filter.

F. CHOICE OF RIGHT COMBINATION OF FILTER AND FOCAL DISTANCE

We understand the right combination of filter and focal distance to be that combination by which the largest possible deep effect is obtained for a fixed value of the surface dose. The right combination is determined by plotting the deep effect as a function of the time of treatment, the variations in this time being obtained in one curve by a variation of the filter, in another by a variation in the focal distance. This is done in Figure 7 for the case of a 20 × 20 cm. opening.

These curves have been plotted by the use of the curves a and b in Figure 3 and Figure 6. Portions of equal slope in the two curves give the right combination of filter and focal distance. It can be seen that a focal distance of between 40 and 50 cm. should be combined with a filter of between ½ and 1 mm. Cu. Increase in deep effect is equally effected by an increase in filter thickness or in focal distance. When a filter of 1 mm. Cu. is used, an increase in deep effect should be produced by increasing the focal distance.

In conclusion we wish to express our appreciation of the assistance offered by Mr. I. E. Beasley, C. Nussbaum, Ph.D., and Mr. B. Rosen in the experimental part of this work, and by Mr. V. B. Seitz, chief of the electromechanical engineering department of the Cleveland Clinic in the construction of the apparatus.

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THE ROENTGEN RAY IN THE TREATMENT OF CARBUNCLES AND OTHER INFECTIONS*

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It is eighteen years since Coyle reported 3 cases of small carbuncles successfully treated with the roentgen ray, with early relief from pain, and with no breaking down or discharge.

Frick, four years later, condemned the roentgen ray in the treatment of carbuncles.

Dunham in 1916 reported the successful treatment of 67 consecutive cases. He found relief from pain and improvement in the patients' general condition within forty-eight hours after the treatment. In some there was little or no discharge; in others there was some breaking down and discharge; but in the majority the carbuncle took on the appearance of a single abscess which made thorough drainage, through a small opening, possible. Dunham concluded that nothing in all roentgen therapy gave such positive and uniformly perfect results as the treatment of a carbuncle.

In 1917 Dr. Ross of Philadelphia reported a very extensive carbuncle of the face cured with the roentgen ray.

From 1917 to 1923 there seems to have been practically nothing in the literature in reference to this work. Lewis of New York, in an excellent article in "Annals of Surgery," November, 1923, reported 16 cases of carbuncle treated with the roentgen ray. Only 2 cases were operated upon. He believes that the roentgen ray is the method of choice in the treatment of this condition. He could find only three references in the literature to the use of radiation in the treatment of carbuncles.

A review of the literature shows that many different methods of treatment are still being used. The leucodescent light, painting with collodion, vaccines, zinc ionization, various cleansing lotions—especially Dakin's—crucial incision with flap undermining, excision, and extensive cauterization are still advocated. Several recent articles by reliable men, citing cases in which radical excision or cauterization was followed by a long drawn out convalescence, with marked scarring and deformity, at times even requiring plastic work, seem to show that the value of the roentgen ray in the treatment of carbuncles and allied conditions is not generally known. Neither in these articles nor, so far as we are aware, in any of the new textbooks on surgery is the use of the roentgen ray in the treatment of carbuncles mentioned.

Since Dunham's article in 1916 we have treated a fairly large number of boils and small carbuncles; but during the past eighteen months we have treated 9 large,

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* Read at the Fifth Annual Meeting, Eastern Section, American Roentgen Ray Society, Atlantic City, N. J., Jan. 24–26, 1924.

been defined and discussed in another paper.[2] The sickness can not be accurately graded, but a rough estimation can be made. We have treated about one thousand patients with penetrating roentgen rays (200 kv.) and are under the impression that this ratio between body dose and roentgen-ray sickness holds good. (See also under 6.)

5. *Radiation of Certain Glands of Internal Secretion.* The adrenals are very sensitive to radiation and several cases have been reported in the literature where death has been caused by radiation of these organs. Apparently a small dose over the adrenals will cause nausea and it is probable that they are sensitive enough to react against an appreciable amount of scattered rays.

It is a common experience in radiation of the ovaries in the treatment of fibroid in which about 30 to 35 per cent of the erythema skindose is used inside the ovaries that these patients also suffer from some nausea and at times vomiting. It seems highly probable that this is due to the influence exerted on ovarian tissue. Some of the other glands of internal secretion as the thyroid may also have an influence when exposed to radiation.

6. *Nervous Strain and Psychic Influences on the Patient.* The psychic and nervous influences play without doubt some part in the production of so-called radiation sickness, as it has been our observation that certain individuals who are very nervous or high-strung are more sick than robust people. Apparently the maintaining of certain fixed positions over a long period of time, causing nervous strain, and the covering with lead rubber for protective purposes, gives them the sensation of restraint which is exaggerated by suggestion either verbally or by putting basins beside them and telling them if nauseated not to move but to use these basins.

When we began treatment with penetrating roentgen rays in 1921 we used a current of 200 kv., and 2 ma., since then we have slowly increased the current up to 8 ma. per tube. For certain cases we now use two or even three tubes simultaneously. The result of the reduced treatment time is that very few patients become sick on the treatment table, and the length of sickness after treatment is markedly reduced.[3] This is especially noted if previous to radiation the patient has had active elimination, emptying the intestinal tract, and has partaken freely of fluids and alkaline drinks. It is customary after the radiation of these patients to give them 1,000 c.c. normal salt solution or bicarbonate of soda 2 per cent, per rectum.

7. *Destruction of Intestinal Mucosa.* Warren and Whipple[4] claim that roentgen-ray sickness is due mainly to the destruction of intestinal mucosa. At the same time they state that such destruction takes place only if the intestines are in the roentgen-ray field. Scattered rays from other parts of the body have no such effect. Then it is evident that the destruction of intestinal mucosa can not be the explanation of roentgen-ray sickness when for instance breasts are radiated. Still roentgen-ray sickness is just as common in such cases (contrary to the experience of Warren and Whipple in raying dogs' chests with standard doses of roentgen ray).

MODERN ROENTGEN-RAY DOSAGE

In the literature there are numerous case reports of injuries to intestines by hard radiation. This is not to be wondered at for it is essential in deep therapy work to calibrate machines and to use radiation charts deduced from this standardization and to figure out what percentage of an erythema dose is produced in different parts of the body, a thing which has been sadly neglected. Much experimentation has been done, especially in Germany, to show how much of a roentgen-ray dose the different organs will stand. It is evident that the dose in a certain organ should be kept below the dose which will cause destruction. It has been stated by several writers that intestines will tolerate 130 to 140 per cent of the skin erythema dose without showing any destructive changes, except in Peyer's patches.[5] It may be that the cases Warren and Whipple refer to did receive more than 130 per cent of the skin dose in some part of the intestines. As far as we can judge from the incomplete data, the case of Rehfisch must have received an overdose; 700 ma. min., at 50 cm. distance with 1 mm. Cu. and 200 kv. seems to be high for an erythema skin dose. The radium dose of 2200 mc. hrs. seems rather large and an addition of 1776 mc. hrs. after nineteen days is undoubtedly too much in combination with roentgen rays. The field also is unusually large (30 cm. diameter). If the diameter of the abdomen is about 20 cm., then we consider that 90 per cent of an erythema skin dose given over one anterior and one posterior field, each 20 × 20 cm. (60 to 80 cm. distance, ½ mm. Cu., 200 kv.) plus 2000 mc. hrs. of radium emanation filtered through 2 mm. of brass would have been a satisfactory dose. The dogs receiving the human erythema dose over seven large fields on the abdomen, as in certain experiments by Warren and Whipple, will certainly receive too much of a dose in the intestines. Even with one and a half erythema dose on one field they still will get up to 140 per cent in some parts of the intestines.

ROENTGEN-RAY IRRADIATION AND INJURIES

With roentgen rays produced at 200 kv. it is easy to get a destructive dose into almost any part of the body without injuring the skin. Lymphocytes are very sensitive to radiation and a leucopenia can be produced with a fraction of a skin dose if it is given over a large field. About one-third of an erythema dose inside the ovaries is enough to sterilize. The adrenals are very sensitive organs. Extreme care should be taken to avoid exposure of these glands. It is an important question whether the case reported by Rehfisch received a considerable roentgen-ray dose in the adrenals or not, and the same question must be made concerning the dogs referred to.

Even in the best clinics in the world under strict supervision of the routine in the carrying out of these treatments it is possible, through errors in technique, for instance, leaving out a filter or miscalculating the time of exposure, to produce very severe injuries both externally and internally. There has been little said in the literature in regard to the injuries caused indirectly in the treatment of cancer of the uterus which may be associated with a latent gonococcus infection. There is no doubt that doses of roentgen ray, over 40 per cent, may stir up a chronic salpingitis with the production of a pelvic peritonitis, and may even cause death. Cases are known in which this occurred without any intrauterine manipulation for the insertion of radium, so that it is possible that this injury was the result of external radiation.

COMPARISON BETWEEN ANIMALS AND HUMANS

It is now a well-known fact that the skin of a number of animals, probably most of them, can stand several times the amount of roentgen rays that human skin can stand. This may be due to the fact that animal skin is an entirely different organ than human skin. Kok and Vorländer define an erythema for mice thus—"the hair should come out at a slight pull." They find then that the erythema dose for mice is one and one-half to two times the human erythema dose. Dr. Gerty Cori of our Institute considers this dose an arbitrary one as "a slight pull" is something variable. She prefers to let the hair fall off spontaneously while the color of the skin does not change (4 ma., 95 kv., 23 cm. distance, 2.5 mm. Al. filter, 50 to 60 min.). Then the depilatory dose for mice is raised to about five to six times the human erythema dose. Warren and Whipple state that the erythema dose for dogs is one and one-half times the erythema skin dose for man. It can not be assumed that the internal organs of man and different animals show the same relative sensitivity as the skin; for instance, the intestines of mice are five to six times less sensitive than that of man. We therefore propose that the dose given to the organs of animals should be measured in percentage of human erythema skin dose. In certain experiments Warren and Whipple gave the human erythema skin dose over seven large fields on the abdomen of dogs with fulminating symptoms which led to the death of the animals in four days. We estimate that these dogs must have received two to three times the human erythema dose inside the intestines, and the destruction they speak of is a natural sequence.

CONCLUSIONS

1. Experimental data obtained from animals which were subjected to roentgen-ray treatments without record of percentage depth dose are of little value in radiation therapy.
2. So-called radiation sickness is not explained on the basis of injury to intestinal epithelium alone.
3. The amount of roentgen ray absorbed in the body can be used as a clinical guide in these sicknesses, unless certain glands are radiated.
4. External radiation in large dosages may, and often does, stir up latent salpingitis.
5. It is absolutely essential to work with standardized roentgen-ray machines and roentgen-ray charts showing the distribution of energy.
6. From our experience with 1000 cases treated with high voltage roentgen ray, if these factors (as above) are adhered to, the unpleasant symptoms, with the exception of headache, nausea and vomiting, are rare.

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A CASE OF PAPILLARY OVARIAN CYST TREATED BY ROENTGEN RAY

BY C. P. LAPE, M.D.

BUFFALO, NEW YORK

THE roentgen-ray treatment of ovarian cysts is mentioned very little in the literature. It may be because they are considered purely surgical, or that they do not occur very frequently. However, one case of papillary ovarian cyst in my experience seems interesting enough to report.

Ewing gives a very comprehensive description of the varieties of ovarian cysts from a pathological and histological viewpoint. He classifies cysts as papillary adenomas, of either the serous or pseudomucinous type, with many mixed and transitional varieties.

Lynch and Maxwell use Pfannenstiel's classification, placing papillary cysts under the serous branch of cystadenomas, with cystadenomas as a type of epithelial new formation. They say these tumors are on the border line of malignancy and quote Pfannenstiel, who claims that 50 per cent of these cases are really malignant. All observers seem to agree that they are of epithelial origin, that they are often malignant either from beginning or by implantation metastases and that they do not metastasize through the blood or lymph streams.

Most of the few references to radiation treatment which I have found have been mentioned under the use of radium. In a summary of a report in the London Radium Institute, Mr. A. E. Hayward Pinch gives cysts in the class for which radium is useless and later mentions roentgen ray as preferable for some conditions, among them, cystic diseases of the ovary. The following is quoted from his report under the heading "cysts." "With regard to cystic conditions in general, radium treatment is of little value, more especially if the cyst be large and tense. When favorably situated, however, removal of the contents of the cyst by incision or aspiration, followed by the introduction of radium into the cyst cavity, may be utilized to induce inflammatory adhesions of the cyst walls and so prevent its reappearance."

Dr. Stacy in discussing the treatment of non-malignant tumors of the pelvis gives ovarian tumors as a contraindication to radium treatment. There was no explanation of this statement, and so ovarian cysts might or might not have been included.

Dr. Scott says in a paper on hemorrhages from the non-pregnant uterus in the absence of neoplasms, "Certain ovarian conditions, such as lutein cysts, are commonly associated with both bleeding and glandular hyperplasia of the endometrium. Finally, the condition can be cured by roentgen-ray or radium therapy and the action of these substances is primarily on the ovaries."

Most surgeons and gynecologists advise postoperative roentgen-ray treatment for malignant conditions of the ovaries.

The case under consideration was referred by Dr. George T. Moseley, after operation, with the following history: An unmarried woman, aged twenty-five, no history of pelvic infection. The patient was first seen in May, 1921, by Dr. Moseley, when she had a tumor in the abdomen about the size of a grapefruit, which was diagnosed ovarian cyst. Operation was advised. Within a few weeks the tumor enlarged rapidly to midway between the umbilicus and the ensiform. Operation was then performed. A large cyst with one compartment was found. It apparently arose from the left ovary but at the time of the operation there was a papillary infiltration into the tube, broad ligament, uterus and intestine. There was no ascites. It was evidently a typical papillomatous cyst, with escape of cells and development of papillae which were friable and markedly congested. The sac proper was emptied and removed but the base could not be removed. She was referred for roentgen treatment six days after operation with a hard mass in the abdomen extending well above the umbilicus, which increased in size for a time. There was moderate anemia present. The condition was considered rather hopeless as it had all the signs of a rapidly progressing, malignant, papillary cyst.

Nothing more, surgically, could be done, so the patient was given roentgen-ray treatments. The family and patient were told that radiotherapy would probably produce a permanent menopause but that it might help the condition. The patient was treated with 110,000 volts by sphere gap reading; 5 ma. 12 in. skin target distance, 3 mm. Al. filter, 10 min. exposure over each one of several areas covering lower abdomen from front, back and sides. The treatment was pushed during the first month after which she was given one series a month for nine months, and then every two months for two series. The mass in the abdomen grew softer at first and then gradually and progressively smaller until it entirely disappeared. The patient's general condition improved until, at present, she seems perfectly well. A report from Dr. Moseley at the time of writing, February 17, 1923, shows the patient still free from symptoms and clinically well.

Of course, there could be some questions raised but I believe the roentgen-ray treatment had a distinct beneficial effect on the condition. Whether it was malignant or not, it was inoperable, and disappeared under roentgenotherapy.

Note. Apr. 8, 1924. The patient is still clinically well.

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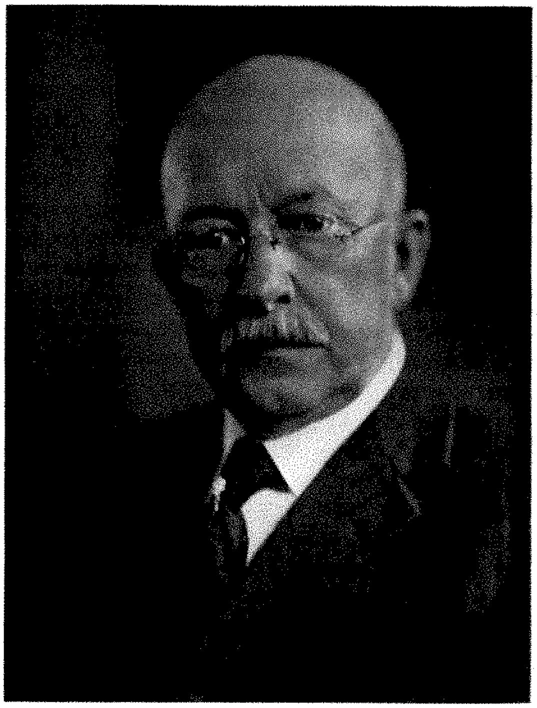
Information of interest to all readers will be found on page vii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

PARK P. BRENNEMAN, M.D.

[October 15, 1859–March 22, 1924



Park P. Brenneman, M.D.
[1859–1924]

Dr. Park P. Brenneman, for many years a member of the American Roentgen Ray Society, died in his office in Lancaster, Pennsylvania, on Sunday, March 23, 1924, while seated at his desk talking with a patient. Dr. Brenneman had been afflicted with a cardiac lesion for several years and had been in poorer health than usual since his return from the recent Atlantic City meeting. He was, however, able to attend to his practice until the day of his death.

Born at Strasburg, Pennsylvania, October 15, 1859, Dr. Brenneman gained his preparatory education at the Millersville State Normal School, and received his medical degree from the University of Pennsylvania in 1884. For nine years after his graduation he practiced his profession in Sidney, Australia. During this period he made a notable collection of animals and birds which is still attractively displayed in his office. After his return to America he engaged in general practice in Lancaster, but he became interested in roentgen rays soon after their discovery, and was the first physician to practice roentgenology in Lancaster.

At the time of his death he was roentgenologist and electrotherapist to the Lancaster General Hospital and St. Joseph's Hospital. He was a member of the American Medical Association; he was for twenty years secretary of the Lancaster County Medical Society and later its president. Dr. Brenneman was a member of Orient Lodge Number 110 F.A.M., New South Wales, and of numerous local societies and clubs. Naturally modest and retiring, he was yet possessed of a personality at once so kindly and genial as to endear him to all who had the opportunity of knowing him.

He was married in 1908 to Mildred Eckert Sutton, who survives him.

D. R. Bowen.

THE STATUS OF RADIATION THERAPY IN CANCER OF THE TONGUE AND FAUCES

It is unfortunate for mankind that the medical profession exhibits one of its greatest weaknesses in its inability to establish a certain and permanent cure for cancer. Early recognition and immediate complete eradication by surgery or otherwise are our only hopes at present. Complete removal is never certain in the dangerous localities. Some progress has been made toward early recognition by propaganda among the laity and by medical training, but no one knows better than the radiologist, who sees most of the advanced cases, that there is much work yet to be done in the teaching of both groups. The neglect of a sore in the mouth that has refused to heal quickly, rectal bleeding ascribed to hemorrhoids without a digital examination higher up and failure to search for the cause of intermenstrual bleeding toward the menopause or recurrence of bleeding afterwards still cause a host of patients to be brought to us with well-advanced cancer.

As radiologists we all realize our conscientious duty to care for many hopeless wrecks to the best of our individual abilities with the resources at our command, but we yearn for a better education of laity and profession toward a general early recognition of malignancy. We have become generally cognizant of the fact that the more often cancer, in many localities, is discovered at a distinctly operable stage, the more certain are the non-surgical measures of radiation and electrodesiccation to succeed. In many instances, such as cancer of the cervix uteri, mouth and tongue, radiation methods, properly employed, are just as efficacious in early cases as surgery. If we are correct in assuming this from reliable statistics, it seems no more than just that we should claim some share of certainties along with the distressing palliative or hopeless cases that are to a certain extent thrust upon us.

Surgery alone in cancer of the tongue and tonsil cannot be regarded as a very great success except in very early cases and in the hands of a few. The non-surgical measures of radiation and electrodesiccation seem to be better adapted to dealing with these lesions, and probably the majority of early cases go to the radiologist along with the more advanced ones, at least in certain geographic localities. In both the tongue and tonsil radium is our most important therapeutic agent because of its peculiar adaptability to different methods of application. Electrocoagulation is likely to be necessary as an adjunct in many instances, and as cervical metastases are inevitable and usually early, the roentgen ray is indispensable.

Carcinoma of the tonsil yields surprisingly good results and the prognosis is far better than in the neighboring structure, the tongue. The anterior pillar forms a peculiar dividing line between hopeful and hopeless lesions of equal size. Surface applications to the tonsillar region are best made by means of a modified tonsil clamp holder or similar device, and implantation of element or emanation needles or bare emanation tubes are very frequently required in addition. Electrodesiccation may also be indicated in some instances, but in the use of this and implantations, the classic anatomic danger must not be overlooked. Even the cervical gland metastases from tonsillar carcinoma respond, as a rule, more favorably to external radiation than do those from the tongue, although the pathological appearance in the cancer cells may differ little or not at all.

In cancer of the tongue the prognosis depends upon the exact location as well as the extent and duration. The less frequent lesions on the tip yield the best ultimate results, and in the absence of metastasis, our non-surgical measures are probably no better than complete wide surgical removal, except possibly in the conservation of tissue.

Success in the treatment of lesions on the side of the tongue, the usual location, will depend largely upon the extent and duration of the growth and the thoroughness of treatment. Metastasis usually occurs early, and implies difficulty in rendering all involved structures accessible to adequate treatment. Except in comparatively early lesions without cervical metastasis these cases are usually regarded as unfavorable ones for surgery and we find nonsurgical procedures displacing surgery generally in proportion to the extent of the growth. It can be conservatively stated as a fact, however, that radiation and electrodesiccation give better results, the earlier and the less extensive the lesion, and probably equal those of surgery at any period. Many radium therapists prefer to make a preliminary surface application of radium over and around the involved area in all cases, and in superficial early lesions this may suffice. In most instances, however, implantations by needles or bare emanation tubes are required in addition. We must recognize the fact that this procedure implies a certain amount of surgical trauma which may or may not tend to promote metastasis. Some radium therapists believe that a preliminary surface application offers some protective influence against this; which is, however, open to question. One should also consider the possibility of dislodging cell emboli by infiltration anesthesia. There is ground for discussion as to the relative merits of bare tubes and needles. The former are certain to create definite though small areas of necrosis, which may probably be disregarded when the implants are made entirely in malignant tissue which is expected to slough away, but to be entirely effectual, some of the seeds must be implanted in more or less normal tissue in order to catch the outlying malignant cells. The resulting necrotic areas in normal tissues promote dense localized cicatrices with rather poor vitality, which do not offer much resistance against recurrences. Moreover, this dense scar tissue frequently causes pain afterwards. Needles, on the other hand, may not give so even a distribution of radiation, and, aside from the greater difficulties of manipulation, their introduction probably produces more trauma.

Electrodesiccation plays a very important part in the treatment of a large number of these cases. There is at present considerable difference of opinion as to the best time for its employment. It may take the place of surface radiation; it may precede or immediately follow implantation or it may be done at or near the height of the reaction, at which time it tends materially to lessen the discomfort from the reaction. If biological studies are of any service to us, the combined effect of the heat plus that of radiation upon cells not directly and completely destroyed by either alone is ideal, and the two procedures should be timed to derive this benefit to best advantage.

There is good reason for believing that severe radium reactions may, in certain instances, tend to promote metastases. The intense inflammatory reactions may widen up lymphatic channels, and malignant cells which have not received a lethal dose may have easier paths through which to spread before the time when the secondary fibrosing effect of the radiation or the closing of lymph channels block them off. This undoubtedly has occurred, and early electrodesiccation may tend to prevent it.

There is always the chance of severe secondary hemorrhage following extensive electrodesiccation, especially when the slough comes away. Ligation is not always sure to prevent this. Moreover, ligation in the presence of metastatic neck glands without an accompanying complete block dissection is often a very bad surgical procedure.

The careful removal of sections of tissue for biopsy is to be encouraged, provided it can be done with safety. Preliminary radiation does not destroy the identity of cancer cells, and may offer a protection against metastasis.

All of these possible variations in technique deserve the most careful consideration, and the biologist and pathologist should be urged to assist us in determining the very best sequences of procedures which will be for the best good of our patients.

When cancer occurs in the tongue back of the anterior faucial pillar it becomes a far more serious problem, especially if it is extensive. The nearer it approaches the epiglottis the more grave is the prognosis, mainly because of the added difficulties of attacking the lesion throughout its entire extent.

The treatment of possible or evident metastatic cervical lymphadenoma is equally as important as that of the primary lesion. It is almost the consensus of opinion that palpable neck glands should be treated thoroughly by roentgen rays or by gamma radiation. If they do not respond, two courses are open: thorough block dissection, provided the case is still operable, or the implantation of radium needles or bare tubes. Implantation of bare tubes is certain to promote the formation of very much devitalized cicatricial tissue which is easily and rapidly infiltrated by any recurrence.

Following radiation and electrodesiccation of mouth cases, the secondary or adjunct treatment is most important, though sometimes neglected. Bad teeth should be removed or otherwise adequately cared for, mouth cleanliness should receive the most careful attention and sloughs should be cut away as rapidly as is safe. The feeding of the patient is most important. There is no time when food of proper caloric value is more needed, and mouth feeding is exceedingly difficult in cases of extensive tongue or tonsil cancer. The duodenal tube may be necessary in some instances, and there may be cases in which a prolonged and exceedingly painful convalescence will indicate a preliminary gastrostomy.

Henry K. Pancoast.

COOPERATION

An ex-president of The American Roentgen Ray Society recently spoke before several hundred New York physicians on "Acute and Chronic Intestinal Obstruction." He made the point clear that the roentgen ray offers a very definite accessory to other means of diagnosis and that it is especially valuable in *localizing* abdominal lesions. He also emphasized the point that no operation should be performed without first making a roentgen examination for purposes of definite localization. These points were modestly submitted and in no sense was the lecturer's stand to be interpreted as making a special plea for the roentgen method to the detriment or exclusion of other means of diagnosis. He was particularly clear and fair in his attitude, and it seemed to most hearers that he had emphasized in the strongest possible manner that the value of the roentgen ray for diagnosis exists in its use in conjunction with all other known means.

When the time came for discussion, a prominent surgeon took the floor and began with the statement that he belonged to "the old-fashioned school of surgeons" and that he could make a complete diagnosis by the old methods. He stated bluntly that the roentgen ray was neither desirable nor to be relied upon, though he gave the lecturer full credit for his sincerity and praised what he called his "unusual ability in diagnosing from the *x*-ray." He maintained firmly, however, his own attitude regarding the position of the roentgen ray and used the argument that operations were often unnecessarily delayed by a roentgen examination to the detriment of the patient.

Here would seem to be well illustrated one of the fundamental difficulties between the roentgenologist of today and his fellow practitioners. Unfortunately, roentgenologists cannot be considered entirely blameless in the matter. Too many specialists are apt to claim perfection for their own speciality to the exclusion of everything else. This attitude is out of keeping with the stand taken by leading roentgenologists and creates dissatisfaction on the part of the medical profession at large, not only with roentgenologists but with roentgenology. Our specialty is one of the youngest departments of the science and art of medicine and would seem to have reached the stage already passed by other branches where it needs to be saved from its friends.

There was a time, not so many years ago, when the roentgenologist was of necessity a propagandist. It is the fate of youth to be on the defensive, and it is no reflection on our specialty that physicians insisted upon "being shown" instead of blindly accepting our word. We have now, however, at our command the results of more than twenty-five years' experience and an accumulated mass of scientific data that places roentgenology upon a foundation so secure that the voice of the propagandist is no longer needed. The accomplishments of the past in our field speak for themselves. We have now reached a time when one of our chief needs is a sane evaluation of the data we have amassed. There is nothing at all to be gained by claiming infallibility for the roentgen ray, or by claiming that its use renders it advisable to discard other true and tried means of diagnosis and treatment. Rather is much harm to be done by such claims. We have a strong conviction that a liberal attitude toward our confreres in other lines of medical work and a conservative estimate of the possibilities of our own method, together with a thorough knowledge of its limitations, are the safe starting points for the progress of roentgenology.

The true scientific spirit is impersonal, and those who have it are willing to give credit wherever it is due, and to sacrifice their own convictions, however much it may hurt, in the interests of the truth.

The valuable contributions of roentgenology to medical science will be much more readily accepted by physicians and surgeons if the roentgenologist adopts an attitude of tolerance toward all who do not yet believe as he does. The only reliable and permanent cure for lack of confidence in roentgenology is that most conventional instrument of the twentieth century—education.

RADIUM THERAPY

We wish to call to the attention of our readers the Radium Report of the Memorial Hospital, Second Series, 1923.[1] A review of this work will be published in an early issue of the Journal; however, its importance to radium therapists warrants a preliminary notice. The report consists of numerous articles by various members of the staff of the Memorial Hospital. The main object of the entire report is well summarized in the early paragraphs of the first article, as follows: "During the past four years, well-supported conclusions regarding the method of choice for different lesions and regarding safe and efficient dosage have been reached. In other words, standards for treatment have been established which are reliable and are possibly a close approach to the best. Moreover, a knowledge of what can be accomplished by radium in the various forms and stages of malignant growths has been acquired, so that a very accurate prognosis can now be given at the outset of treatment. This knowledge was not acquired sufficiently early for its incorporation in the present publication in the form of records of apparently complete retrogressions. The period covered by this report, like that of the preceding one, has been a period of growth; an attempt to discover just what radium is able to accomplish in the cure of cancer; a period of development of methods and dosage; of determining what forms of cancer can be benefited by radium, and to what extent."

The extensive experience of the members of the staff of this hospital in the treatment of malignant disease and their painstaking interpretation of results warrant a careful study of every article in the report. There is nothing in the book, however, that will be read with greater interest and profit than the Mutter Lecture by James Ewing on "An Analysis of Radiation Therapy in Cancer." This lecture was presented eighteen months ago, and at that time some of its conclusions seemed rather radical; but experience since then has served to justify practically all of them. A short quotation from this lecture is given on page 410. This is only one of many significant and illuminating statements found throughout the lecture.

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[1] Paul B. Hoeber, Inc., New York.

Subscribers to The American Journal of Roentgenology and Radium Therapy *visiting New York City, are invited to make the office of* The Journal *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

AMERICAN RADIUM SOCIETY

NINTH ANNUAL MEETING

The Ninth Annual Meeting of the American Radium Society will be held at the Hotel Drake, Chicago, Illinois, on Monday and Tuesday, June 9 and 10, 1924. This is immediately following the Radiological Society's scientific sessions but preceding the meeting of the American Medical Association with Section on Radiology.

The following is a preliminary program of the American Radium Society meeting which includes subjects of vital scientific interest to every member of the Society, and none should fail to attend.

In addition to the Tuesday afternoon clinics conducted at the Mercy Hospital amphitheater, the Local Committee has been successful in completing the final arrangements for a most interesting Monday evening banquet at which addresses will be presented by Dr. James T. Case, President, Professor Regaud of Paris, Dr. Howard Kelly of Baltimore, and Dr. James Ewing of New York. The subject of Dr. Regaud's address will be "Biologic Aspects of Radiotherapy"; the subject of Dr. Kelly's address will be "That which is Assured in Radium Therapy"; Dr. Ewing will speak on "The Present Status of Radiotherapy."

Since all the scientific sessions will be held at the Hotel Drake it would be advisable to make reservations for accommodations immediately.

Members of the American Medical Association interested in radium therapy are cordially invited to attend both the scientific and clinical sessions.

PRELIMINARY PROGRAM

Schmidt, Dr. William H., Philadelphia, Pa. "Indications for the Use of Radium and other Methods in the Treatment of Cancer."

Schreiner, Dr. Bernard F., Buffalo, N. Y. "Results Obtained by Radiation Therapy at the New York State Institute for the Study of Malignant Disease."

New, Dr. Gordon B., and Figi, Dr. F. A., Rochester, Minn. "Treatment of Fibroma of the Nasopharynx

Pancoast, Dr. Henry K., Philadelphia, Pa. "Some Observations on the Treatment of Carcinoma of the Larynx."

Grier, Dr. G. W., Pittsburgh, Pa. "Treatment of Malignant Disease in the Mouth."

Simpson, Dr. Augustus, Washington, D. C. "Radium in the Treatment of Tonsils."

Pomeroy, Dr. L. A., and Milward, Dr. Frank, Cleveland, Ohio. "The Use of Radium in the Treatment of the Female Urethra."

Young, Dr. Hugh H., Baltimore, Md. "Survey of Results Obtained with Radium in Carcinoma of the Prostate and Bladder."

Soiland, Dr. Albert, Los Angeles, Calif. "The Treatment of Inoperable Cancer of the Pelvis by Radium."

Benson, Dr. F. C. "Simple Enlargement of the Prostate."

Samuel, Dr. Ernest C., New Orleans, La. "Radiation in the Treatment of Carcinoma of the Uterus."

Failla, Dr. G., New York City. "A Brief Analysis of some Important Factors in the Biological Action of Radiation."

Clark, Dr. Wm. L., Morgan, Dr. J. Douglas, and Asnis, Dr. Eugene J., Philadelphia, Pa. "Objections to the Use of Radium Emanation in Bare Tubes, with Clinical and Histological Observations."

Lee, Dr. Burton J., New York City. "Technique and Results in the Treatment of Mammary Cancer by Radiation."

Demonstrations of clinical results and technique will be given at the Mercy Hospital amphitheater on Tuesday afternoon by the following Fellows from Chicago:

Beck, Dr. Emil G. "Carcinoma of the Jaw and Cheek."

Hanford, Dr. Chas. W. "Carcinoma of the Esophagus."

Kretschmer, Dr. H. L. "Treatment of Carcinoma of Prostate with Radium."

Simpson, Dr. Frank E. "Cancer of the Tongue."

Bundy, Dr. Harry E. "Benign Hemorrhage of the Uterus."

Schmitz, Dr. Henry. "Carcinoma of the Breast."

JOINT MEETING

The Western Section of The American Roentgen Ray Society will hold a joint meeting with the Pacific Coast *X*-Ray Society in Seattle and at Mt. Rainier, July 21–24, 1924. A detailed announcement of the meeting and program will be made in the next issue of the Journal.

THE FIFTH ITALIAN CONGRESS OF MEDICAL RADIOLOGY

The Italian Society of Medical Radiology holds meetings of national scope every eighteen months. The organization of such a meeting is somewhat different from those of American societies and it may be well to give a few details. The

Congress, as it is called, has an honorary president, a president, a vice-president, and a secretary separate and distinct from the corresponding officers of the society. With the exception of the honorary president, these officers are chosen from the leading radiologists of the city in which the congress is to be held, or its vicinity. There are, in addition, an honorary committee and an executive committee. The former is composed of prominent citizens of the locality, such as senators, representatives, bank presidents, newspaper directors, army officers, professional men, etc. The executive committee is chosen from members of the society.

The Fifth Congress was held in Palermo, October 18 to 21, 1923. The honorary president was His Excellency Corbino, Minister of National Economy, who happens to be an eminent physicist, interested in radiology. The president was Dr. G. Scaduto, the vice-president, Dr. G. Arnone, and the secretary, Dr. S. Sgroi. The presidents of the honorary committee were the Mayor of Palermo and the Prefect of the Province. These details are given simply to show the official recognition which medical radiology receives in Italy. In this connection we may add that a reception was given to the members of the society and guests by the mayor at City Hall.

The congress was very well attended—more than five hundred taking part in it, directly or indirectly. A few foreigners were also present. Among these was Dr. Heuser, of Buenos Aires, who had previously attended the Chicago meeting of the American Roentgen Ray Society.

About 150 papers were on the scientific program. Naturally most of these were not read, in spite of the fact that the meeting lasted four days. More than one-half of the papers were on roentgen-ray diagnosis, very few on radium therapy. There were several papers on the biological effects of radiation, and on technical developments. The society had asked a few prominent members to prepare special reports on definite topics and a good deal of time was allowed for their presentation and discussion. The titles were "Pneumoradiography," by Dr. M. Gortan, of Trieste; "Radiodiagnosis of the Urinary Tract," by Dr. G. Boidi Trotti of Turin; and "Roentgen Therapy of Cutaneous Diseases," by Dr. A. Rossi, of Parma.

The writer, being a physicist, cannot give a competent résumé of the medical papers. It seems, however, that as regards therapy, the general trend is towards the administration of divided doses, adjusted according to the requirements of the individual patient. The massive treatment idea, sponsored by the Erlangen school, seems to have fallen into disfavor. Incidentally it might be added that the same feeling exists in other parts of Europe, including Germany. The writer, however, did not visit Erlangen.

It may be of interest to American radiologists to know that in Italy roentgen-rays are used, apparently with success, for the treatment of malaria in quinine-resistant patients. The enlarged spleen in such cases is irradiated with fairly small doses, as in America. The field of radiotherapy is constantly being extended, as shown by the titles of some of the papers on the program: "Results of *X*-Ray Treatment of Lethargic Encephalitis," by S. D'Arman; "Contribution to the Radiotherapy of Diseases of the Nervous System," by V. Podestà; "Radiotherapy in Tabes Dorsalis," by S. D'Arman; "Irradiation of the Spleen in Tuberculosis according to Dr. Manoukline's Method," by M. Gortan; "*X*-rays and Rabies (Considerations Relative to One Clinical Case)," by M. Pidone; "Roentgen Rays in Ophthalmology," by G. Villasevaglios; "Contribution to the *X*-Ray Treatment of Neoplastic Tuberculosis," by S. Migliorino.

The discussions in general were very interesting. From these one got the impression that Italian radiologists, as a rule, have a broad knowledge of the subject. Of particular interest was the discussion of Dr. Ghirlanducci's method of "variable filtration" in combination with ionophoresis for the treatment of certain types of cancer. Briefly the method is as follows: The tumor tissue is infiltrated with metallic ions electrolytically and *at the same time* *X*-radiation is applied in steps with increasing filtration. The purpose of ionophoresis, of course, is to increase the secondary radiation within the tumor. The advantage of the "variable filtration" is not so evident. However, it is contended by the advocates of this method that larger *total* doses can be administered by starting with unfiltered rays and gradually increasing the filtration, than if a single filter is used. Another justification for this practice is based on the assumption that some cells in the tumor may react better to radiation of one wave length, while others may be more sensitive to rays of another wave length. Some of the reasons given do not appear strictly logical. In reality the subject requires more careful experimentation before any definite conclusions may be reached.

An important feature of the Congress was the large exhibit of roentgen-ray apparatus and accessories. All the Italian concerns were well represented. The most important German manufacturers had extensive exhibits. A Spanish concern had reserved a large space, but most of the apparatus did not arrive in time. Only one American roentgen-ray apparatus was exhibited.

On account of the high rate of exchange obtaining at present, Americans cannot meet European competition in this field. This is especially marked in the case of hot-cathode roentgen-ray tubes, which can be bought in Europe for a fraction of their cost here. However, at present European tubes have not the current carrying capacity of ours, but they will stand the same voltage. The usual milliamperage is 2.5, sometimes 4 as a maximum.

By visiting the exhibit one could form a very good idea of the present status of this art in Europe. In regard to deep therapy machines one could notice a trend towards the use of the closed-core, oil-immersed transformer, although machines with induction coils in air were present in considerable numbers. It is the impression of the writer that in general our machines are better, but some details have been worked out more fully in Europe. Considerable progress has been made in France and Italy as well as in Germany, in the problem of rectification by means of kenotrons. One machine shown in Palermo made use of kenotrons but no condensers were provided. While this scheme gives silent rectification with no moving parts, it suffers from the disadvantage that practically the whole voltage wave is utilized rather than the crest, resulting in unnecessary heating of the target. Condensers, however, may be added to this outfit so that a steady current is supplied to the tube always at the maximum voltage. Such a machine, operating at 200 kilovolts, is on the market in France. The writer saw one at the Physics Exhibit in the Grand Palais in Paris and was told that about twenty were either in actual operation or in the process of installation in France. One had just been installed at the Radium Institute. If this type of machine proves reliable in practice it will undoubtedly supersede the rotating switch apparatus.

In forming an opinion of representative men in radiology, personal conversations outside of the meeting room were of the greatest value. It may be said here that they show a very broad knowledge of the subject and a realization of its limitations, which, however, they do not permit to dampen their enthusiasm. The writer takes this opportunity to thank them for the kind reception accorded him at the Congress and in the different clinics he visited.

G. FAILLA.

New York City.

THE LEONARD PRIZE FOR RESEARCH

THE American Roentgen Ray Society will award $1000.00 to the author of the best piece of original research in the field of the roentgen ray, radium, or radioactivity. The competition is open to anyone living in the United States, or its possessions, in Canada, Mexico, Central or South America, Cuba or other islands of the Western Hemisphere.

The field of research includes discovery, invention, improvement of method, or investigations to prove or disprove any theory or problem, whether old or new, which has a direct bearing upon the use of roentgen rays, radium, or other radioactive substances.

This competition is not open to any research involving a patent or copyright, and the submission of any research work for this prize carries with it the understanding that the subject matter will remain open to free use for the general good.

The committee reserves the right to withhold the award if in its judgment no piece of research offered possesses sufficient merit. It also reserves the right to divide the award if two or more papers are judged to be of equal merit. A certificate of honorable mention will be given to the author of meritorious research which has been submitted, but which has not received the prize.

Papers presented to the committee for consideration must be typewritten in the English language and submitted not later than May 1, 1925. They must be written on plain paper and enclosed in a plain envelope so that the identity of the contestant will not be known to the committee until after the award is made. A plain sealed envelope marked with the title of the paper and enclosing the contestant's name must accompany the manuscript; and after the award has been made, this envelope will be opened and the identity of the winner revealed.

Papers, records, or material are received in this competition only with the understanding and agreement that any work receiving award or honorable mention may be published in THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY at the discretion of the research committee. All expenses of publication will be borne by the Journal. Papers not published will be returned to the authors.

The piece of original research receiving award must be presented before the American Roentgen Ray Society at its annual meeting in September, 1925.

The prize is offered in an altruistic spirit for the promotion of useful research, with the approval of the National Research Council. It commemorates the name of a martyred member of the American Roentgen Ray Society, Dr. Charles Lester Leonard, who paid the supreme penalty for his pioneer research in the field of the roentgen ray.

COMMITTEE

George W. Grier, M.D., Chairman, 8088 Jenkins Arcade, Pittsburgh, Pa.

F. M. Law, M.D., 576 Fifth Ave., New York, N. Y.

Gordon E. Richards, M.D., 325 St. George St., Toronto, Ontario, Canada.

MEETINGS ON RADIOLOGY AT A.M.A. CONVENTION

Officers

Chairman: W. F. Manges, Philadelphia.
Vice-Chairman: Albert Soiland, Los Angeles.
Secretary: M. J. Hubeny, Chicago.

Thursday, June 12, 9 a. m.

1. Chairman's Address. W. F. Manges, Philadelphia.
2. Roentgen-Ray Studies in Hydrocephalus (Lantern Demonstration). P. M. Hickey.
   Discussion to be opened by G. L. Davenport.
3. A Radiographic Study of the Infant's Chest as Seen at Birth. W. Walter Wasson.
   Discussion to be opened by Charles C. Grandy.
4. Radiographic Localization of Lung Abscess with the Hirtz Compass: Preliminary Report (Lantern Demonstration). L. R. Sante and E. P. Lehman.
   Discussion to be opened by Edwin S. Blaine, and Evarts A. Graham.
5. The Importance of Careful Roentgen-Ray Investigations of Apical Chest Tumors (Lantern Demonstrations). Henry K. Pancoast.
   Discussion to be opened by William A. Evans.
6. Some Observations on the Use of the Roentgen Rays in the Diagnosis of the Pericardium (Lantern Demonstration). George W. Holmes.
   Discussion to be opened by P. D. White.
7. Results of Medical Treatment of Gastric Ulcer as Observed by Serial Roentgenography. Louis Gregory Cole.
   Discussion to be opened by Bertram W. Sippy.
8. A Study of Thirty-One Cases of Complete Transposition of the Viscera, with Remarks on Etiology (Lantern Demonstration). L. T. LeWald.
   Discussion to be opened by James T. Case.

Friday, June 13, 9 a. m.

9. Studies on the Effect of Roentgen Rays on Glandular Activity; The Effect on Gastric Secretion of Exposure of the Abdominal and Thoracic Areas in Roentgen Rays; A Note on Roentgen Cachexia (Lantern Demonstration). A. C. Ivy and B. H. Orndoff.
   Discussion to be opened by Charles L. Martin.
10. The Reaction of Different Types of Abdominal Tumors to Radiation. A. U. Desjardin.
    Discussion to be opened by George E. Pfahler.
11. End-Results Observed in Carcinomas of the Uterine Cervix with Radium and Roentgen-Ray Therapy (Lantern Demonstration). H. Schmitz.
    Discussion to be opened by John F. McCullogh.
12. Comments on the Use of Radium for Intra-Oral Cancer. Albert Soiland.
    Discussion to be opened by Frank E. Simpson.
13. The Treatment of Hyperthyroidism by the Roentgen Ray: Results in 125 Cases. T. A. Groover, A. C. Christie and E. A. Merritt.
    Discussion to be opened y Robert G. Allison.
14. Relations of Roentgen-Ray Signs to Symptoms in Duodenal Ulcer. A. W. Crane.
    Discussion to be opened by E. C. Ernst.
15. The Pathologic Basis for Irradiation of Tonsils. W. W. Watkins.
    Discussion to be opened by Robert A. Arens.

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

A COMPARISON OF THE TELEOROENTGENOGRAM WITH THE ORTHODIAGRAM*

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PEKING, CHINA

INTRODUCTION

In the course of the extensive use of roentgen rays in the study of hearts by Bardeen,[1] Eyster,[3] Meek and other Wisconsin workers, it has become more and more obvious that estimates of cardiac area from teleoroentgenograms frequently fail to check with similar measurements made from orthodiagrams. Since both methods are used clinically, it seemed worth while to undertake the following investigation in the hope of finding the causes and perhaps the remedy for these discrepancies between the two.

Table I is a comparison of teleo areas with ortho areas in 32 cases, some normal, some with cardiac lesions, selected at random from a series of several hundred subjects examined by Dr. Eyster. In column "T" are teleo areas in square centimeters corrected for distortion, in column "O" orthodiagram areas. Under "D" appear percentage variations of teleo areas from ortho areas.

The teleoroentgenograms were made by the standard method[1] with the tube at a distance (in this case 7 ft.) and the subject seated, leaning forward 20°, and holding his breath in moderate inspiration.

The orthodiagrams were made with the subject sitting erect and breathing quietly.

Fifty-four per cent of these cases show the teleo 10 per cent or more larger than the ortho, the greatest variation being 27 per cent, the least 1 per cent, and the average 11 per cent. In 2 cases the teleo is smaller than the ortho, 5 per cent in one, 1 per cent in the other case. Applying Pearson's Product-Moments formula

$$r = \frac{MT \times O - MT \times MO}{\sqrt{MT^2 - M^2T} \times \sqrt{MO^2 - M^2O}}$$

the correlation "r" is found to be .9122 where r = the correlation between teleo area and ortho area; MT = the mean of the teleo areas; MO = the mean of the ortho areas; MT times O = the mean of the summation of the products of the individual T areas by O areas; MT^2 = the mean of the summation of the squares of the T areas; MO^2 = the mean of the summation of the squares of the O areas. M^2T = the square of the mean of the summation of the T areas and M^2O = the square of the mean of the summation of the O areas.

The standard deviation (sigma) for T is 22.01, that for O being 23.04. This is obtained from the formulae

$$\text{Sigma } T = \sqrt{MT^2 - M^2T}$$

$$\text{Sigma } O = \sqrt{MO^2 - M^2O}$$

The findings are in agreement with the idea that having the subject lean forward increases the teleo area on an average of about 10 per cent over the area in the erect position[1] but they show also that even when the 10 per cent correction is applied, many cases show a deviation above 10 per cent, one case being as high as 17 per cent. Cases published by Karshner and Kennicott[4] show individual variations ranging from 0 to 60 per cent. When similar measurements on the same individuals show variations much larger than the normal variations from the normal tables, interpretation becomes exceedingly difficult.

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* (From the Physiological Laboratory, University of Wisconsin.

In the teleo position (Fig. 1), the subject leans forward to throw his heart against the anterior chest wall and holds his breath in a moderate inspiration to assure a sharp diaphragmatic shadow and thus aid in outlining the apex of the heart.[1]

In the ortho position (Fig. 2), he sits erect and breathes quietly. A specially balanced fluoroscope would be required to allow doing the ortho with the subject leaning forward, and the time required for the examination is so long that the breath could not be held except by great effort. It is quite simple, however, to make the teleo with the subject in the ortho position. This we proceeded to do, using the apparatus shown in Figure 3.

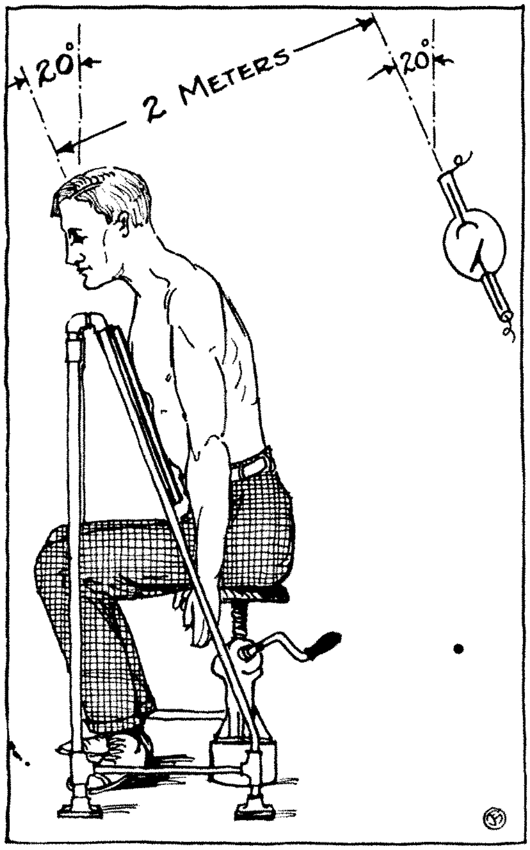


Fig. 1.

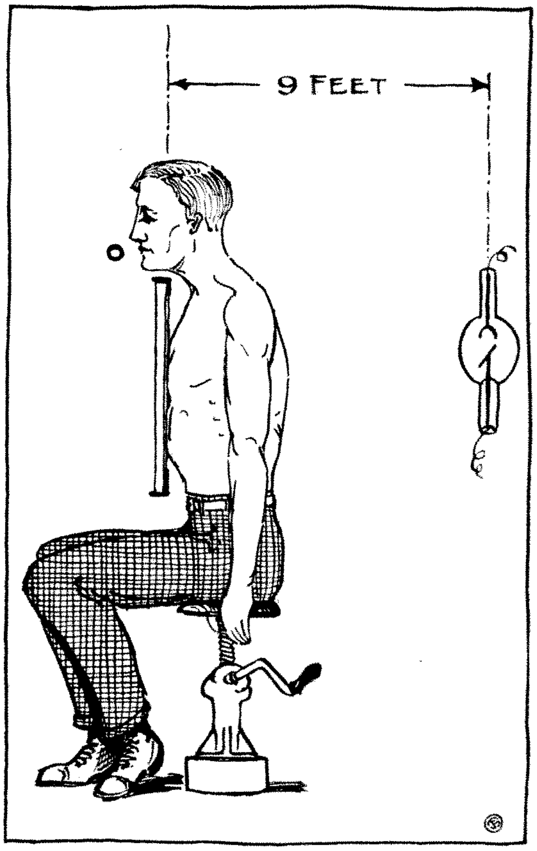


Fig. 2.

The apparatus consists of a specially constructed film changer for 10 × 12 cassettes mounted rigidly in front of a vertical fluoroscope. A 10 × 12 fluoroscopic screen is mounted in a frame exactly the same size as the cassettes so that it can be substituted for one of them. Clips on the front of the screen frame receive window glass cut to size and bound about the edge with adhesive tape.

The fluoroscope is provided with cross wires accurately centered in the line of the central ray from the tube and the counter balance weights have been shifted to the side so that when the tube carriage is moved to the upper limit of its travel there is an unobstructed opening behind the subject. Opposite this opening, but back at a point 9 ft. from the screen, a second tube is mounted in a commercial type of tube stand which has an automatic vertical stereoscopic shift. This tube is set so that when it is at the middle of its shift the central ray falls on the center of the fluoroscopic screen.

The fluoroscopic tube, a 10 ma. radiator type Coolidge tube, is energized from a small transformer mounted on a wall shelf, the control box being at the left of the observer's chair. The distant tube, a medium focus regular Coolidge type, is supplied from an interrupterless transformer apparatus. Magnetic triggers on the film changer and tube shift are in series with a push button on the interrupterless transformer switch board.

This done, the fluoroscopic tube is raised to the upper limit of its travel, the fluoroscopic screen removed and replaced by a loaded cassette, and a teleoroentgenogram made without changing the position of the subject. Centering the heart fluoroscopically allows the use of 10 × 12 films instead of the customary 14 × 17 size thus considerably decreasing the cost.

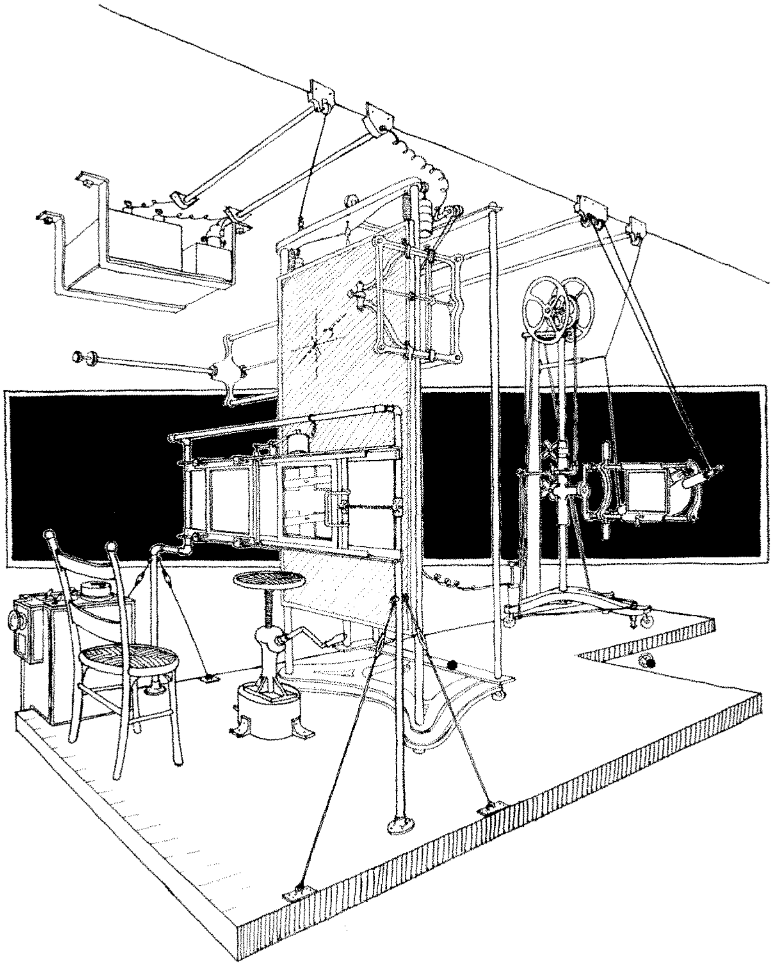
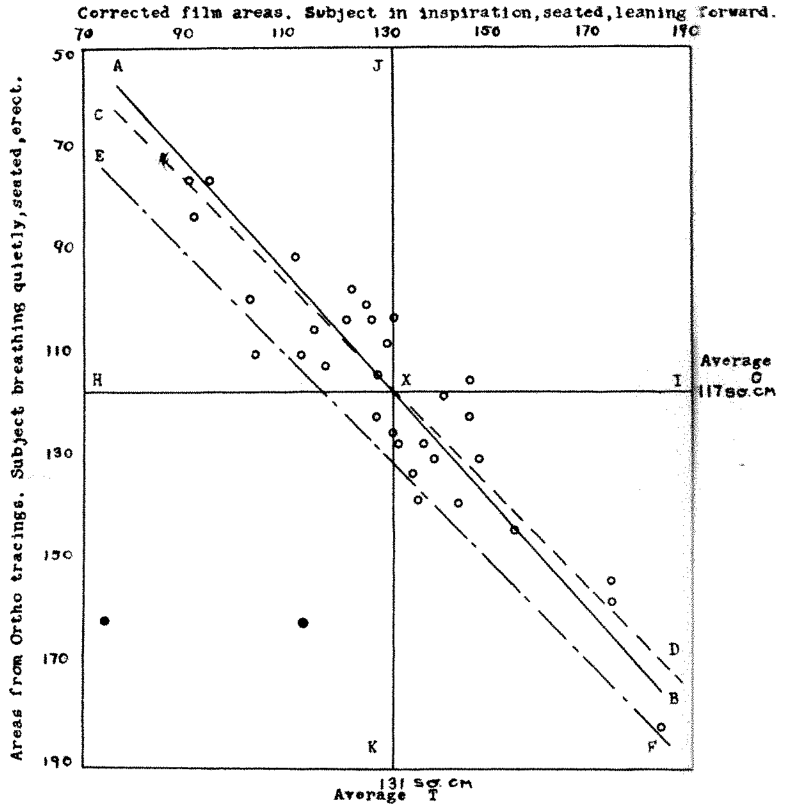


Fig. 3.

Operation. The subject is seated on an adjustable stool which is fastened to the floor just behind the fluoroscopic screen. Under fluoroscopic control this stool is raised or lowered until the center of the heart shadow coincides with the center of the screen. An orthodiagraphic tracing is then made on the tape bound glass and later transferred to paper for measurement.

Correction for Distortion by Divergence of the Rays. Even at a film-target distance of 9 ft., there is, of course, some distortion of the heart shadow, the amount usually being computed by triangular proportion on the assumption that the mean plane of the heart is in the average case 8 cm. from the film.[1] As a matter of fact the surface of the chest never comes up to the plane of the film—being held away from it by the thickness of the cassette, cassette changing mechanism and the wood or celluloid window against which the subject leans. A more accurate and a simpler method of computing distortion is to erect a rectangular sheet of lead parallel to the celluloid window and 8 cm. back of it, make a teleoroentgenogram, measure with a planimeter the area of the shadow cast by the lead on the film and compare this with the actual area of the lead sheet. Using this method it was found that the distortion for this particular apparatus was 5 per cent.

Graph Made From Data in Table I



r = .9122 = tangent ∠ 42° 22' = tangent ∠ A X J

FIG. 4.

Experiments. Records were made of 32 males and females, mostly young adults; some normal, some with definite cardiac lesions.

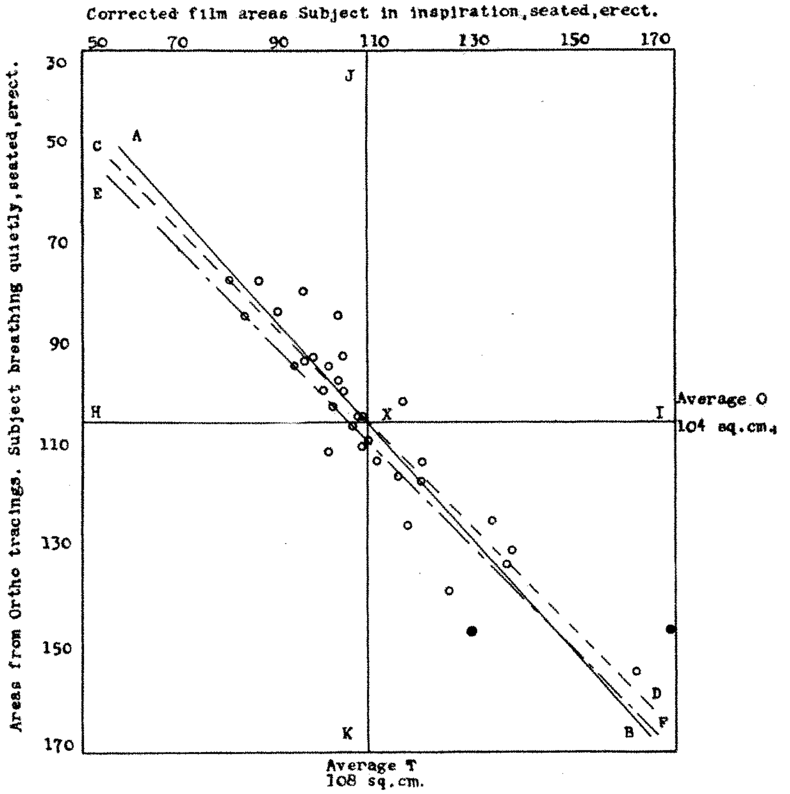
An orthodiascopic tracing was made during quiet breathing, then with the subject holding the same position, two teleoroentgenograms were made, the first during quiet breathing, the second during a held inspiration.

Data. Table II shows teleo areas of subjects in inspiration, sitting erect, compared with ortho areas in the same subjects sitting erect and breathing quietly. Twenty-two per cent of the cases show teleo areas varying from the ortho areas by 10 per cent or more. The largest plus variation is 23, the largest negative 10, the average being plus 4. In 4 cases the two measurements are identical. The correlation factor is .926.

In Table III teleo areas of subjects sitting erect and breathing quietly are compared with ortho areas made under identical conditions. One case shows a teleo 11 per cent larger than its ortho but in all the others the variations are less than 10 per cent and equally distributed between plus and negative so that the averages are identical. The correlation factor is .951.

Findings from Tables I, II and III are graphically shown in Figures 4, 5 and 6, where areas from teleo films, measured in square centimeters and corrected for distortion are plotted as abscissae with ortho areas in square centimeters, as ordinates.

Graph Made From Data in Table II



r = .926 = tangent ∠ 42° 48' = tangent ∠ A X J

FIG. 5.

The solid line HI is the average of the ortho measurements, JK that of the teleos. The dotted line EF indicates the position that would be taken by the points if every teleo area were exactly equal to its corresponding ortho measurement, CD being the position that would be taken if every teleo bore the same relation to its ortho that the average teleo bears to the average ortho. The solid line AB shows the mean position of the points as they actually lie. It is located by extending the line AX which is the side of an angle AXJ whose tangent is equal to the correlation factor of the values involved.

Discussion. In the graph from Table I practically all of the points are displaced upward from the line EF which is accounted for by the fact that the average teleo is 11 per cent larger than the average ortho. Moreover when this 11 per cent correction is applied, that is when we consider CD as the base line, the points are rather widely scattered above and below it leaving a strong probability of a large individual variation.

The graph from Table II shows the line EF much nearer to CD since the average teleo is now more nearly the same size as the average ortho. The points are also packed somewhat more closely about their mean AB.

Table III gives a graph in which EF and CD are identical because the average teleo and average ortho are identical. The points are quite closely packed about AB and the chances are strongly in favor of an individual variation of well under 10 per cent. There is reason to believe that the variations remaining are really a measure of the personal error in making the readings, and it is logical to suppose that, allowing for distortion, the heart shadows as thrown on the film in the case of the teleoroentgenogram and the screen in the orthodiagram are identical for a given case.

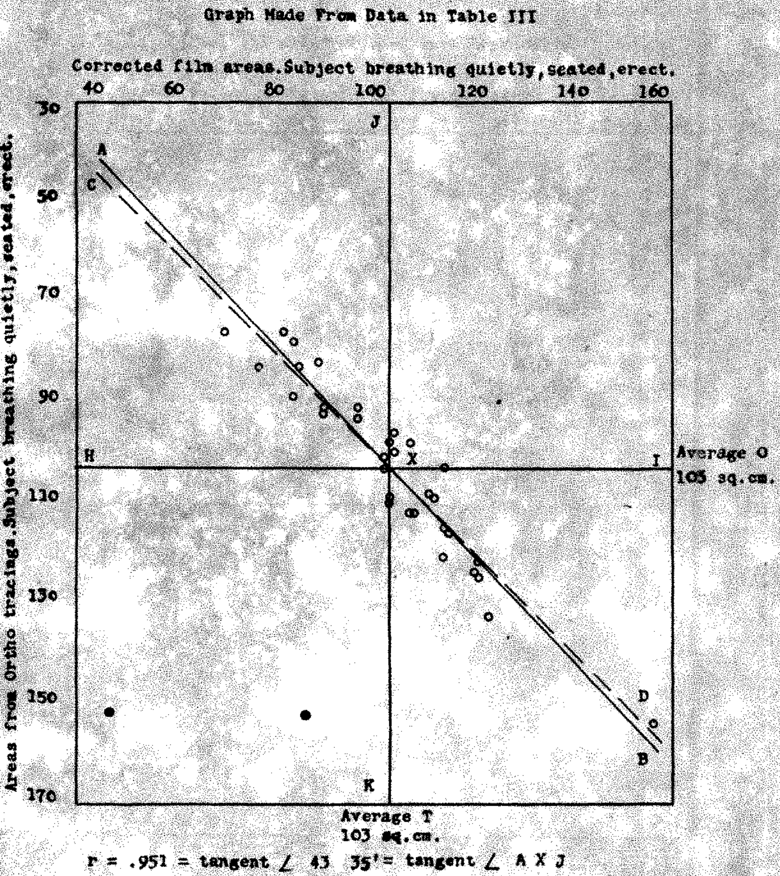


FIG. 6.

It is usually admitted that an orthodiagram made by a skilled worker contains certain information about the condition of the heart chambers which cannot be obtained from the flat teleoroentgenogram.[4] On the other hand the objectiveness of the latter makes it of definite value in determining the size of the heart as a whole.

If we are to use both methods certainly we should be able to compare the findings. Making identical the conditions of the two examinations seems to make this possible, and it may be that the average of the two is the measurement we should use for comparison with the normal tables.

SUMMARY

Individual variations between teleoroentgenograms made with the subject in inspiration and leaning forward and orthodiagrams with the subject erect and breathing quietly are larger than normal variations from the normal tables.

The variations are less when the subject sits erect for the teleoroentgenogram.

When the subject sits erect and breathes quietly during both teleoroentgenogram and orthodiagram, individual variations are almost always less than 10 per cent.

TABLE I

	Case	T	T^2	O	O^2	T × O	D
	H4	174	30276	154	23716	26796	+13
	H5	104	10816	110	12100	11440	−5
	H6	128	16384	116	13456	14848	+10
	H7	118	13924	112	12544	13216	+5
	H8	135	18225	113	17689	17955	+1
	H9	91	8281	76	5776	6916	+20
	H10	92	8464	83	6889	7636	+11
	H13	130	16900	108	11664	14040	+20
	H312	95	9025	76	5776	7220	+25
	H1	136	18496	138	19044	18768	−1
	H2	148	21904	130	16900	19240	+14
	H3	116	13456	105	11025	12180	+10
	H15	126	15876	100	10000	12600	+26
	H19	127	16129	103	10609	13081	+23
	H20	132	17424	127	16129	16764	+4
	H21	128	16384	122	14884	15616	+5
	E411	141	19881	118	13924	16638	+19
	E343	131	17161	103	10609	13493	+27
	E397	103	10609	99	9801	10197	+4
	E10	184	33856	182	33124	33488	+1
	E11	112	12544	91	8281	10192	+23
	E12	113	12769	110	12100	12430	+3
	E13	123	15129	97	9409	11931	+27
	E16	146	21316	122	14884	17812	+20
	E15	146	21316	115	13225	16790	+27
	E17	155	24025	144	20736	22320	+8
	E18	174	30276	158	24964	27492	+10
	E21	137	18769	127	16129	17399	+8
	E25	144	20736	139	19321	20016	+4
	E22	139	19321	130	16900	18070	+7
	E98	122	14884	103	10609	12566	+18
	E72	131	17161	125	15625	16375	+5
Total...........	.....	4181	561717	3756	457842	505525	
Average.........	.....	130.65	17553.65	117.375	14307.56	15797.65	
Sigma...........	.....	22.01	....	23.04			
r = .9122 P.E. r = .029							

T = Corrected film area. Subject in inspiration, seated, leaning foward.
O = Cardiac area from ortho tracings. Subject breathing quietly, seated, erect.
D = Percentage deviation film area from ortho area.

Table III

	Case	T	T^2	O	O^2	T × O	D
	H4	156	24336	154	23716	24024	+1
	H5	103	10609	110	12100	11330	−6
	H6	115	13225	116	13456	13340	−1
	H7	108	11664	112	12544	12096	−4
	H8	123	15129	133	17689	16359	−8
	H9	70	4900	76	5776	5320	−8
	H10	85	7225	83	6889	7055	+2
	H11	102	10404	103	10609	10506	−1
	H12	97	9409	93	8649	9021	+4
	H13	111	12321	108	11664	11988	+3
	H312	82	6724	76	5776	6232	+8
	H306	84	7056	78	6084	6552	+8
	H307	89	7921	82	6724	7298	+9
	H308	114	12996	115	13225	13110	−1
	H309	90	8100	91	8281	8190	−1
	H310	104	10816	96	9216	9984	+8
	H311	97	9409	91	8281	8827	+7
	H313	90	8100	92	8464	8280	−2
	H314	77	5929	83	6889	6391	−7
	H316	107	11449	112	12544	11984	−4
	H317	102	10404	101	10201	10302	+1
	H318	107	11449	98	9604	10486	+9
	H319	103	10609	98	9604	10094	+5
	H320	114	12996	121	14641	13794	−6
	H321	120	14400	124	15376	14880	−3
	H15	104	10816	100	10000	10400	+4
	H17	121	14641	125	15625	15125	−3
	H18	112	12544	109	11881	12208	+3
	H19	114	12996	103	10609	11742	+11
	H21	121	14641	122	14884	14762	−1
	H322	103	10609	110	12100	11330	−6
	H323	84	7056	89	7921	7476	−6
Total..........	.....	3309	350883	3304	351022	350486	
Average........	.....	103.40	10965.09	103.25	10969.43	10952.68	
Sigma..........	.....	16.54	....	17.58			
r = .951 P.E. r = .016							

T = Corrected film area. Subject breathing quietly seated, erect.
O = Cardiac area from ortho tracings. Subject breathing quietly, seated, erect.
D = Percentage deviation film area from ortho area.

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There is finally a chapter devoted to pre- and post-radiation treatment.

One is impressed by the thorough mastery of the subject which the author shows and which well bears out the statement of Döderlein in the introduction that von Seuffert is suited as are very few to attempt to give us a book of practical value. The fact that he is not primarily a laboratory man but a clinician as well makes his viewpoint all the more valuable. His book represents very fairly the status of radiation therapy in Germany along gynecological lines, at the time of its publication.

Throughout the book there are many interesting personal observations, among which there are two of striking interest. He mentions that it has been his experience that following radiation there has been a marked improvement in patients afflicted with chronic constipation, and similarly considerable benefit in cases of prolapse. This latter effect has evidently been due to the fibrosis produced. No explanation is offered as the reason for the improvement in chronic constipation.

E. C. Samuel and E. R. Bowie.

Die Röntgenbehandlung innerer Krankheiten. (Roentgen treatment of internal diseases.) Edited by Fritz Salzmann. Price; paper, $2.00, cloth, $2.50. Plates 55. J. F. Lehmann, München, 1923.

The necessity for a critical review is quite apparent when one considers the enormous progress made during the past six years in the relatively young science of radiation therapy. Such a review, and much more, is offered in the present volume. The seventeen authors who have collaborated in this work present not only a review, but also well-balanced presentations of their various specialties. In every chapter, the development of radiation therapy is traced and its bearing upon the clinical side is discussed, the entire organism being taken into consideration. An interesting aspect of the book is discussion of the problems still under dispute. Measurement and dosage are considered in two chapters, and the practical applications in every branch are set forth. Any tendency to one-sided treatment seems to be corrected by the fact that in some instances the opinions differ. The title of the book is not sufficiently comprehensive, because, in addition to the treatment of pulmonary tuberculosis by Bacmeister, there are chapters for each of the following: Radiation therapy of glandular and peritoneal tuberculosis, by Stepp; roentgen therapy of the structural tissues, the non-tuberculous bone and joint diseases, and the treatment of malignant tumors. Moreover, two extensive chapters are presented which deal with the physical and biological foundations of radiation therapy. It is therefore quite evident that this work covers the wide field of general and special radiation therapy. The surgeon will find interest in the chapters on Basedow's disease, hypophyseal tumors and their treatment by roentgen radiation of the nervous system; the gynecologist, in the chapter on roentgen therapy in disturbances of the internal secretions of the ovary. For the first time, the internist is offered a compilation of Groedel's experiences upon the effects of radiation in diseases of the cardiovascular system. Separate chapters are also given to the hitherto poorly understood conditions of bronchial asthma and diseases of the thymus and the pancreas. A short discussion is given of roentgen injuries and the extent of the liability of the roentgenologist. The masters in the profession of radiation therapy will find this a work for ready reference and the beginner will have the advantage of the combined experiences of outstanding experts.

G. F. Haenisch.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

Rost, G. A. Radiation therapy of skin cancer. *Strahlentherapie*, 1923, xv, 782.

The author distinguishes between primary and secondary cutaneous cancer. He follows Darier in his differentiation of the primary group in spindle-cell, basal-cell carcinoma, and a metatypical growth uniting the characteristics of the two previous groups. The first comprises about 50 per cent of all cases of cutaneous cancer. The second, 30 to 40 per cent, and the third, 10 to 15 per cent. Spindle-cell carcinoma is malignant and generally attacks the face, ears, mouth, and in some instances the rest of the body. It most often starts as a wart-like formation on the skin, and as a "verucose leucoplacia" on the mucous membrane. It develops comparatively rapidly, the lymph glands are soon involved, and death often occurs within a few years from cachexia and hemorrhage. Its response to radiation varies. In the average case it is not very prompt, and most failures of this therapy are registered in this type of cutaneous cancer. Basal cell cancer is most often located on the upper two-thirds of the face, especially in older people. It may appear on the extremities, lips, tongue, and genital organs. Its development requires from twelve to thirty years. It is obstinate, and prone to recurrence when operated upon. Its malignancy is entirely local, and the growth rarely spreads to the glands and metastases are not formed. Darier distinguishes five types, one of which is the so-called ulcus rodens. Basal cell carcinoma is very sensitive to radiation.

Basal cell carcinoma may be treated with roentgen rays, while on the whole operation is to be preferred on parts of the body which respond less readily to radiation. These regions are the penis, hand, ears, the lower part of the lower extremity, and feet. Inoperable tumors may be rendered operable by roentgen treatment. Where cosmetic effect is of importance, radiation will be employed. This is desired, for instance, in the naso-labial region, and the corners of the eye-lids. The extent of the lesion, either on the surface or in the deeper layers of the skin, will constitute a contraindication for operation.

The author considers radium and roentgen rays as of equal value. The same results may be seen from both, and their choice will greatly depend on circumstances. However, it seems that in those carcinomata which no longer respond to roentgen rays, and in some that do not respond to it from the onset, radium might be of use. The same may be the case in the reverse.

Most practitioners go beyond the cutaneous erythema dose, sometimes to the third of its extent, and 3 to 4 mm. Al. is used as filter. The author's normal dose is 90 to 110 per cent of the cutaneous erythema dose.

Rost is of the opinion that it is impossible to give a review of the results obtained by various authors because the methods employed are not the same.

Simmons, C. C., and Daland, E. M. Cancer: Delay in the surgical treatment. *Boston M. & S. Jour.*, Jan. 3, 1924, cxc, 15–18.

The following questions were asked, and the answers recorded in the 519 cases of cancer which entered the Mass. Gen. Hosp. in 1917–1918.

1. Character and date of first symptom.
2. Date of first consultation with a physician.
3. Date on which operation was advised and by whom.
4. Date of admission to the hospital.

(*a*) The average duration of the disease before admission into the hospital, 12.49 months.

(*b*) The average delay on part of patient from onset to consultation with a physician, 5.4 months.

(*c*) The average delay from first consultation to operation was advised, 3 months.

The average delay in breast cancer was 12.4 months. In 1921–1922, a similar study was made of the 539 cases. In cancer of the rectum, the operability of those cases reaching the surgeon, is about 50 per cent; the operability of the disease is, therefore, not over 25 per cent. If the percentage of cases of cures of cancer of the rectum, operated on, is 25 per cent, the percentage of cures of all cases of the disease, is 6 per cent. There is but slight difference between the findings of 1917–18, and those of 1921–22.

The average duration of the disease, before admission, was 11.6 months as compared with 12.49 of previous series. The average delay from onset to first consultation, was 4.6 months as against 5.4 months for the previous series.

Delay from first consultation to operation advised, 2.9 months as against 3 months.

A tabular statement is given of the entire facts.

Simpson, Frank Edward. Recent advances in radium therapy. *Chicago M. Rec.*, Oct., 1923, xlv, 795–801.

In treatment of malignancy by radium, both underdosage and overdosage must be avoided. Underdosage may fail to influence, and overdose may hasten the patient's end.

The advantages of treatment by radium emanation are that the most lethal rays are brought into close contact with cancer cells for about five days, that the effect is selective—the cancer cells are more injured than the normal, and that the dosage is quite exact, 0.5 millicuries per c.c. of tissue, is ordinarily enough.

The ampoules must not be implanted too near large vessels, hollow viscera or bone.

Draining lymphatic glands should receive heavy radiation with 500 to 1000 or more millicuries placed 3 or more cm. from the surface.

Of 17 carcinomata of the tongue, 12 appear to be clinically well for periods from three months to two and one-half years. One case (inoperable) is still uncertain; 4 cases (inoperable), have died since treatment.

Perrola, Albert. The treatment of inoperable cancers of the cervix before and after the employment of radium. (Le traitement des cancers du col inoperables avant et depuis l'emploi du radium.) *Rev. Francaise de Gyn. et Obst.*, May, 1923, xviii, 321–329.

The author collected 50 cases of inoperable cancers of the neck of the uterus which he classifies into:

(*a*) Inoperable cancer of the neck: cratered, light infiltration of the cul-de-sac and surroundings; 30 cases.

(*b*) Inoperable cancer of the neck: cratered, block neoplasm; 20 cases.

The age varied from thirty-four to eighty years with an average of fifty-four years.

As for the treatment instituted the greater part of our patients (42) have had curettage of the neoplastic mass followed nearly always by cautery with a red hot iron (30 cases), by the thermocautery (11 cases). More rarely, the cauterization was done by nitric acid (three times), the tincture of iodine (2 cases), nitrate of silver (one case) and formol (one case).

There was no recovery and but little amelioration in these 50 cases. He then gives 46 cases treated with radium divided as before:

(*a*) 25 cases inoperable, cratered, with light infiltration of the cul-de-sac and surroundings.

(*b*) 21 cases inoperable, cratered, block neoplasm.

We have exact information of the final result of each case of the patients who figure in the following table:

(*a*) 25 cases inoperable:
  (1) 22 cases:
    6 months shortest time survived.
    67 months longest time survived.
    28½ months average time survived.
  (2) 3 cases yet alive with duration of clinical cure:
    66½ months, 67½ months, 74 months.
(*b*) 21 cases inoperable, block neoplasm:
  (1) 19 cases.
    shortest survival 3½ months
    longest survival 49½ months
    average survival 14 months.
  (2) Two patients,—condition unknown.

Though based on so small a number of cases, the figures of our statistics have significance. Three patients with inoperable cancer of the neck yet alive five years after the first application of radium and one six years and two months and among those dead the average survived twenty-eight and one-half months in the first group and fourteen months in the second.

Garrahan, Juan P. Pleurisy of the apex in tuberculous children. (Pleuritis de vertice en los niños bacilosos.) *Semana méd.*, Aug., 1923, xxx, 281.

This article refers to seven children from six months to six years of age, presenting positive tuberculous reaction with clinical-radiological signs.

When the apex is invaded the roentgen shadow is uniform, or almost uniform, directly comparable to the shadow of the heart, or somewhat less in density, occupying the apex with more or less clear inferior limit. In some cases, the shadow fills almost the entire side, but the base and costo-diaphragmatic space were always free. Nearly always the roentgenographic image was more extended than was verified by percussion.

The roentgenographic examination in all cases which gave positive tuberculin reaction proved the existence of a tracheo-bronchial adenopathy.

There were diverse functional symptoms varying with the evolution of each case, but in general it may be said that all of the children who presented vertex symptoms were thin and pallid, more or less without appetite, febrile, coughing in some cases. Nevertheless, the relative good general condition was in contrast with the intrathoracic condition.

A case of typhoid of medium intensity was followed three months after recovery by a sudden attack of intense lumbar pain, accompanied by clonus but no Babinski sign.

The roentgenogram showed lateral osteophytes on the inferior border of the second lumbar and upper border of the third. The appearance differed from the usual one of osteoarthritis in that there was a thinning of the intervertebral space between the second and third vertebrae while the joint-slits above and below were of normal width. The lower border of the body of the second and upper border of the third vertebrae did not present sharp contours.

The appearance somewhat resembles secondary neoplasm but in such cases the primary growth can usually be located.

Alamartine and Charleux. Degenerated papilloma of the bladder, treated by curietherapy. *Journ. d' Urol.*, Oct. 1923, xvi, 291–294.

This case, female, 53 years old, entered the service of Prof. Rochet, Sept. 8, 1921, and died June 3, 1923. No special antecedent history; had been operated on for acute appendicitis. The day following operation, the urine was cloudy and bloody. It was then learned that for ten years previously, there had been hematuria, at first spontaneous and intermittent and that for six months it had been continuous. At the same time, there were signs of an intense cystitis. At once a degenerated papilloma was thought of, and a fixed catheter tried, but it gave no relief. On Aug. 16, cystotomy was performed. This disclosed a large vesical tumor, implanted by a broad base in the left side of the bas-fond of the bladder.

Radium, as an application, was preferred to removal, on account of the bad general condition, and the sessile tumor. Radium was applied a second time, four days later. Two tubes of 50 mgm. each, were deeply placed in the tumor.

The radium was kept in place 48 hours, the result being satisfactory. The bleeding lessened rapidly, as did the cystitis. The cystotomy wound closed in 3 months.

Oct. 25, 1921, it was found that the lesion was smaller although base of the bladder was found by rectal touch to be very hard. On Jan. 21, 1922, the action of the radium was clearly manifest, cystoscopy showing only an irregular floor with a small elevation, 1 cm. high. On Mar. 2, 1922, around the left uteral orifice, there was a lightly granulated and cicatricial zone.

The local and functional cure was maintained for a year and a half. The general condition remained good, neither hematuria nor cystitis reappeared. The bladder capacity remained about 150 grammes.

However, two months after the intervention, in Nov., 1921, the patient suffered with the right kidney, which became very large. A hydronephrosis and secondary renal tumor were considered. Nephrotomy was done, which disclosed only a polycystic kidney. Histological examination showed no neoplastic lesion of the renal parenchyma. On Dec. 5, 1922, the patient reentered the clinic on account of a fistula at the line of the former nephrectomy, and died Jan. 3, 1923 of caseous bronchopneumonia.

Angle, E. J. and Owen, L. J. Treatment of cancer of the lower lip with special reference to radium and electro-coagulation. *The Urolog. Cutan. Rev.*, 1923, xxii, 688–692.

In that group of prickle-cell carcinomas of the lower lip when no metastasis to the submental or submaxillary lymphatics has occurred, there is the same certainty of cure by means of radium, as in the basal-cell growth of the upper part of the face.

In a second group, uncertainty enters into the prognosis, when metastasis to the adjacent glands has taken place. It is not always possible to know if metastasis has taken place. A third group of cases is that in which the deeper lymphatics and perhaps the thorax become involved, in which only palliative results can be hoped for; deep cervical metastasis does not prove the presence of thoracic cancer and some of these cases, if the lymphatic chains are treated actively, will get well.

Douglas Quick is quoted as saying, "It would seem, therefore, that the adoption of a radical block dissection, as a blanket rule, is a frantic rather than scientific effort." Boggs says: "Cancer cells located in sublingual, submaxillary, submental, parotid, and cervical glands can be successfully destroyed by implanted radium, in more advanced cases than can be removed by surgery, without producing any deformity." In neck dissection there is widespread opening of lymphatic channels which may increase the malignant metastasis.

Destruction of the primary lesion on the lip, by means of electro-thermic coagulation, seals the lymphatics, without manipulation of the tissues, and is a sound procedure. Beyond the area of actual coagulation there is a zone of heat which while not destructive to the connective tissue cells, is destructive to the cancer cells.

Corbus is quoted as saying, "that diathermy can be used to destroy cancer in areas not accessible by any other means; that we must use a current low in voltage and high in amperes, only enough voltage being used to drive the current through the tissues."

The great variation in physiologic reactions to raying tissue with radium, has defeated all attempts to formulate an accurate "cancer dose." A cell is less resistant during mitosis, and repeated attacks strike at a greater number of cells in this less resistant state, without giving the tumor time for growth, incident to what would be a stimulation exposure, if long periods elapsed between treatments.

Why basal-cell growths should be the rule above the level of the mouth, on the face and prickle-cell cancers comprise nearly all malignancies of the lower lip, is not clear.

A resumé of results is given and 5 cases reported in detail.

Boothby, Walter M. The total and basal metabolism in exophthalmic goiter. *Minn. Medicine*, Feb., 1924, vii, 91–92.

The basal metabolic rate is valuable in the differential diagnosis of diseases of the thyroid, and in measuring the intensity of the hyperthyroidism. As the total metabolism in twenty-four hours is increased to even a greater extent than the basal metabolism, the former can be used as a diagnostic aid, and the variation in weight as an index of the course of the disease and the patient's condition. A gain in weight indicates that the patient is doing well, while a continued loss of weight suggests that operation will not be well stood.

About two years ago, H. S. Plummer demonstrated that the gastrointestinal crises of exophthalmic goiter can be stopped by administration of Lugol's solution from 30 to 60 drops for three or four days and then 10 drops daily. Its effect is quite as striking and dramatic as that of insulin in diabetes. Kocher's warning against the indiscriminate use of iodine in goiter should be heeded, because it is likely to change an adenomatous goiter without hyperthyroidism to adenomatous goiter with hyperthyroidism. Therefore, before Lugol's is used, a correct differential diagnosis must be made.

Borak, J. Uric acid elimination of normal individuals upon exposure to roentgen rays. *Fortschr. a.d. Geb. d. Roentgenstrahlen*, 1923, xxxi, 298.

Experiments showed that endogenous uric acid elimination, which is independent of the food taken, depends on the dose and certain individual variations when normal individuals are radiated, also on the part of the body to which the rays are applied, or the organs contained in these parts.

When medium doses were applied to the thorax, abdomen (not including the liver and spleen) and the lower extremities, no influence on the uric acid elimination was noticed. Twenty-four hours after radiating the liver, and the spleen, uric acid was increased, and associated with urate sediment, in the first phase. Then followed decrease below the normal average, during the second phase, and then a renewed increase of the third phase which lasted several days.

The author is of opinion that radiation causes a washing out of purin deposits from the radiated organs, just as do atophan and large quantities of fluid.

Caudière, Marcel, and Henry, J. R. Histological classification of tumors of the testicle. *Gaz. des Hop., Par.*, Nov. 24, 1923, 1505. (Cont. Dec. 1, 1923, p. 1537.)

Tumors of the testicle form a particularly complex group in which the study and histological classification remained long obscure by reason of the complexity of the facts and the difficulty of their interpretation.

The fundamental paper of Pilliet and Costes gave, for the first time, the basis for the classification of tumors of the testicle in accordance with their embryonic origin. A classification of tumors of the testicle, which is not based on the embryonic origin of the different types, cannot be satisfactory. The genital glands by their morphogenesis and histogensis, contain histological elements of very different origin and different potentiality in the production of tumors. It is well, then, to fix in mind the essential embryological points of the genital glands and the origin of their different elements.

The embryology of the testicle is then given.

The histological classification of tumors of the testicle is simple when the embryological origin is taken as a basis for each type. Each distinct type of normal element corresponds to a type of tumor.

Moreover, we must add tumors of mixed origin, embryomas which are frequently found in the genital glands. These tumors may be classified in the following manner: Embryonal (Tumeurs germinatives); interstitial endocrine tumors (Tumeurs interstitielles endocrines); excreto-renital tumors (Tumeurs excreto- genitales); connective tissue tumors (Tumeurs conjunctives); tunica vaginalis tumors (Tumeurs de la vaginale); mixed tumors; embryomas and their derivatives.

1. Embryonal tumors. Seminiferous adenoma. These are rare tumors first described by Pick in 1905, then studied by Chevassee, Ledene, and Pierre Nudal. On section, these

tumors present the aspect of semi-transparent nodules, white or yellow, of a size varying from 1 mm. to 1 cm., and included in the parenchyma of the testicle. Histologically, they are composed of a group of tubes, wrapped on themselves, a group separated from parenchyma of the testicle, surrounded by a connective tissue capsule. These tubes are smaller than normal seminiferous tubules, and are formed by a thin, connective tissue wall lined with cellular elements poorly limited and more or less fixed into a syncytium, recalling strongly the fetal seminiferous tubules.

2. Seminiferous epithelioma, seminoma. The term "seminoma," designates a very characteristic type whose peculiar histological character suggests that it is derived from the male germinal epithelium. This is found commonly in the testicle, exceptionally in the ovary, and Americans say that, practically, seminoma and embryoma are the two types of tumors of the testicle which are much the most frequent.

Interstitial endocrine tumors. Hyperplasias. These hyperplastic tumors of the interstitial cells have seldom been found except in ectopic testicles. They have the aspect of small lobules isolated in the parenchyma of the testicle more or less voluminous. From a histological standpoint, as these elements are only abnormal in number, it is a question whether they are properly called tumors.

Adenomas and interstitial epitheliomas. These tumors are developed in the ectopic or in the normally placed testicle. They may be bilateral. Their volume may be the size of a hen's egg, and their weight more than 200 grams.

3. Tumors, excreto-genital. The Wolffian tubules appear not to give rise to tumors. Those attributed to them, appear to have another origin, and to belong to the embryomas.

4. Connective tissue, and tunica vaginalis tumors. Without doubt, the common connective tissue of the testicle can be the origin of fibromas and sarcomas, but these tumors appear to be extremely rare. A number of tumors for a long time considered sarcomas, are in reality either embryomas or seminomas.

5. Embryonic tumors, mixed tumors. Teratomas and embryomas, so-called mixed tumors, are frequently observed in the testicle, characterized histologically by elements derived from the three blastodermic leaves (tridermic tumors of Münch). They are divided into teratomas and embryomas. The teratomas are tumors enclosing organized remnants more or less recognizable.

Between teratoma and embryoma, there then is only the difference of degree in the complexity of the mixture of tissues of organic remains. They may degenerate into cancers of rapid growth with invasion of distant parts.

Benign neoplasms. The greater part of the mixed tumors belong to this group.

With this article, there is a bibliography of 55 articles.

Boyd, M. L., and Floyd, Earl. The value of pyelo-ureterograms in obscure kidney lesions. *Jour. M. Assn. of Georgia*, Nov., 1923, xii, 429–440.

This article calls attention to the necessity of proper technic to get the result, calling attention to Case V of those he reports in which the patient was cystoscoped, given functional tests, had several pyelograms, but without correct diagnosis until a pyelogram was taken with the patient standing and 10 c.c. of sodium bromide solution injected through the ureteral cathete which showed the kidney lying with the lower pole overlapping the ilium and its pelvis at about the level of the fourth lumbar vertebra.

The symptoms which may arise from kidney lesions are so diverse and so closely resemble those of lesions of other organs that often all of the diagnostic methods fail until a pyeloreterogram has been made, particularly in right sided nephroptosis in stout people. Sometimes the pain from the abnormally placed kidneys is felt in front near the region of the appendix, and as there is often associated gastrointestinal disturbance it is not out of place to suspect appendicitis. A pyelo-ureterogram is indicated in almost every kidney case that is to be operated on. The first exposure for a pyelo-uretergram is taken with patient lying down, employing a lead infiltrated catheter, with the tip in the pelvis of the kidney not in the ureter or a calyx. Inject a few c.c. less of the solution used (sodium iodide or bromide) than the measured kidney capacity. Take the second exposure with patient in semi-sitting or standing position; the third after the catheter has been withdrawn to the lower ureter. Between these exposures the catheter is allowed to drain out the injected fluid, and reinjections are made before each exposure. There follow the details of [illegible] cases.

Chapman T. L. The value of basal metabolism in a general surgical practice. *Minn. Med.*, Feb. 1924, vii, 89–90.

The studies of Boothby and others appear to justify the conclusion that 95 per cent of all abnormally increased metabolic rates are due to hyperthyroidism either of exophthalmic goiter or adenoma with hyperthyroidism, providing febrile states are eliminated, and proper conditions essential to physical and mental repose and the various necessary inactivities and inhibitions are complied with.

Lowered rates are found in the largest percentages in myxedema of varying grades of development and inanition from restricted food intake.

Of first importance in surgical practice are the basal rates in the diagnostic estimates of goiters, giving positive or negative information that may be of prime importance.

A large number of colloid goiter patients with coincident nervous circulatory peculiarities, can be catalogued on a more certain diagnostic basis than before, by means of basal rate readings.

Crile, G. W. The cancer problem. *J. Am. Dent. Assn.*, Jan. 1924; 3–5.

Crile quotes tables of 168 cases of buccal cancer, 13 per cent of which were due to defective teeth. These included 45 cases of cancer of jaw and mouth, 30 per cent of which were due to dental conditions. It is obvious that chronic irritation of tongue and buccal cavity by teeth or ill fitting dental work cannot fail to be a distinct menace. He says, "I have never seen a cancer of the mouth in a perfectly sanitary mouth with normal teeth." Cancer is always preceded by a remediable precancerous condition, which in the mouth can often be seen and corrected.

These cancers do not metastasize so readily to distant parts as do the cancers of other regions of the body. The collar of lymphatics in the neck form an almost impassable barrier through which cancer rarely penetrates.

Cancer of each part of the head seems to follow a law of its own, so far as its primary extension is concerned. Cancers of the skin, mucuous membrane, of the cheeks, and of the edge of the jaw do not usually metastasize; cancer of the lip almost uniformly metastasizes to the lymphatic glands under the jaw; cancers of the floor of the mouth into the glands of the same side, etc. However, the metastasis may occur at any site high or low on the right or left side. Early cancer of the mucous membrane of the gums or cheeks does not demand excision of the glands, while cancer of the lip, however early, demands complete excision of all lymph nodes draining the involved tissue. Cancer of the tongue or lips calls for complete removal of the glands of the neck on both sides. Cancer of the jaws demands a less radical procedure.

"As for the care of the precancerous lesion, radium and roentgen ray play an important part. The proper application of radium to an obstinate ulcer of the lip, gum or cheek, is the most efficient prophylactic measure. Once the cancer has developed, surgical operation alone remains, but when this is done the best results come when a single treatment of deep accurately measured roentgen ray or radium dosage is added. In the precancerous stage the cooperation of the dentist surgeon and roentgenologist is important to the patient."

Delbet, Paul, and Thomas, Joseph. The actual situation in cancer therapeutics. *Les Néoplasmes*, May and June, 1923, ii, 119–124.

This article proposes to give fairly both sides in the various methods used in the cancer fight. All available cancer was treated in the first place by radium. If the neoplasm is small a complete cure results without the risks of operation, if large, subsequent operation is made easier and the risk of dissemination during operation made less.

But radium should not be applied in a haphazard way. It should be buried within the mass, with precision at the selected place, and when so done, is truly a surgical operation. The surgeon makes the diagnosis, but the radium therapeutist applies the radium, selecting the positions and dose. The application of radium in the larger neoplasms, should be followed by the work of the surgeon.

Eisen, Paul. Duodenal regurgitation. *Jour. of Radiol.*, Nov., 1923, iv, 388–390.

This is a study of regurgitation from the duodenum into the stomach. In a series of 109 cases from Aug., 1921 to Oct., 1922, reverse peristalsis was met with nine times, 4.7 per cent. The clinical significance is not yet known. In one case the stomach was nearly empty, at the end of three hours, and nearly full again at the end of six. It must be considered as a contributing factor in gastric retention.

Esau. Median nasal cleft associated with congenital dermoid. *Fortschr. a. d. Geb. d. Roentgenstrahlen.* 1923, xxxi, 262.

A girl, aged seventeen, was presented for examination on account of a flattening of the upper part of the nasal ridge which did not form an acute angle, but a surface of up to 2.5 cm. The roentgenogram showed the nasal bones to be moved apart in the upper portion, below in the median line. A light space was seen in the interspace which reached far under the glabella. This light space was the picture of a cyst which, when operated, proved to be, as had been surmised, dermoid. A mass of fair hair was removed from between the gaping nasal bones, and the walls of the cyst were removed for some distance under the glabella and the vomer.

The region of the nasal and orbital bones has often been reported as the site of dermoid cysts. This condition in the girl was congenital, and had been noticed as a protrusion soon after birth.

Fleischer, F. Does the patella bipartita belong to the juvenile osteochondric diseases? *Fortschr. a. d. Geb. d. Roentgenstrahlen*, 1923, xxxi, 209.

A soldier, aged twenty-eight, showed roentgenological signs of Schlatter's disease. Bony particles were contained in the patellar tendon, and one of them evidently had been fractured recently. In the left knee a patella bipartita existed. Both conditions are rare. The anomaly and the disease had evidently existed for years, but the patient had not much discomfort from either. A certain cartilage and bone weakness had probably existed and a deformation and pathological condition had developed in consequence of some functional strain. The damage is liable to be wrought during the time of growth, resulting on one side in a division of the patella, in the other in a faulty distribution of bony particles.

Fox, Harold. Concurrent hydropericardium and pneumothorax. *J. Am. M. Ass.*, Feb. 9, 1924, lxxxii, 467.

This combination of pathological conditions is rare. The case reported was a married man, aged thirty-six, who first noticed trouble in chest when nineteen. On July 25, 1922, first noticed heart beat on right side. Maximum intensity 1½ inches to right of sternal margin. On Oct. 15, there was a sudden attack of pain at the back of left shoulder. Temperature 102°. This lasted about a week, heart appeared to patient to be farther to the right of sternum. Jan. 3, 1923, he was seized with a sudden short pain in the posterior to the left shoulder pain going down to costal margin on left side of thorax; breathing sounds on left side diminished, increased in intensity on right side; heart sounds difficult to hear. Point of maximum intensity 2 in. to right of sternal bone in fifth interspace. Pulsation could be felt all over right lower thorax and upper abdomen on the right side. The percussion now ranged from dull to flat. The line between liver and pericardial dullness could not be made out. The liver dullness extended four finger breadths below the costal margin. A peculiar splashing sound could be heard at times over the area of cardiac dullness. The patient appeared to be in a state of shock. The roentgen ray revealed a well defined shadow above and to the left of the cardiac shadow, which on succession, showed a well marked fluid wave, and which, on changing position showed a changing fluid level. There was a shadow indicating collapse of nearly all of the left lung. A diagnosis of pericarditis with effusion, with pneumothorax and collapse of the major part of the left lung was made. The case was operated, the pericardium drained, the left chest aspirated, removing 500 c.c. of air. Respiration with pressure apparatus restored the lung function, and the heart beat returned to left side, the patient making a recovery.

Fleischer, F. Multiple epiphyseal disturbances in the hands. A so-far unknown localization of juvenile osteochondropathy. *Fortschr. a. d. Geb. d. Roentgenstrahlen*, 1923, xxxi, 206.

A girl, aged fourteen, noticed swelling in the proximal portions of the interphalangeal joints of all fingers of both hands. The condition had been diagnosed as syphilis of the bones by another physician. The Wassermann reaction was however negative and the roentgenogram contradicted this opinion. The clinical course and the age of the patient did not point to osteochondritis, dactylitis, osteoperiostitis, bone gumma or syphilitic arthritis. The Pirquet reaction was negative. The roentgenogram showed no periosteal reaction, the bony structure was clearly delineated and differentiated from the articular cleft. No circumscribed light spots or general calcium depletion were seen. The course was slow. For these reasons caries, spina ventosa and articular fungus were barred. Osteomyelitis was very improbable on account of the epiphyseal involvement and the symmetrical location. Late rickets attacks the entire bony system, and in juvenile cases is restricted to the lower extremities and the trunk. Moeller-Barlow's disease, arthritis, trauma, neoplasm, and syphilis did not seem to be the correct etiology. It was a condition of the growing stage of life, a juvenile osteochondroplastic disease.

Gragert, O. A simple procedure for the production of artificial pneumoperitoneum; *Ztbl. f. Gyneck.*, 1923, xlvii, 144.

An instrument was devised by the author, for insufflating air into the peritoneal cavity before putting the patient in front of the screen. It consists of a blunt drain with an olive tip, which is used as an insufflation needle, much as Hoehne has used in provocative camphor oil treatment before operations. It is like a common lumbar puncture tube. After removing the olive a sterile rubber tube is attached which carries a three-way valve. It leads into a sterile Jeannet syringe of 200 c.c. volume. By opening or closing the valve, air can be aspirated and slowly insufflated by the syringe which then serves as a pump. The air is sterilized by a cotton plug in a glass drain which is inserted near the point where the air enters the valve.

The intestines are well evacuated and the patient put in the dorsal or high pelvic position, is given 0.005 gm. morphine half an hour before the insufflation is made. The umbilical region is disinfected and the skin scarified with a sharp scalpel, and the drain with the olive passed in. The olive tip is then removed and the rubber tube leading to the three-way valve is drawn over the end of the drain. Then the air is aspirated by means of the syringe, the valve turned and the air slowly insufflated; then the valve is turned back. If one is in doubt whether the needle is in the abdominal cavity the stethoscope will give information.

Generally 800 c.c. of air will be enough. After insufflation the drain is removed and the slight wound treated aseptically. The air will be absorbed spontaneously within four days. If one wishes to remove it, one can make another puncture. It is advisable to keep the patient prone for some time after the examination.

GLASSER, OTTO. Newer investigations of gamma-ray dosage of radium. *J. Radiol.*, Nov., 1923, iv, 386–388.

The laws of distance and absorption, do not apply, because of the scattered rays.

Isodoses are the dose curves resulting from studies made with a standard radium tube, and an ionization chamber, the required dose being calculated on this isodose curve. These isodosic curves vary with the form and material used in the containers and filters for radium.

HERRNHEISER, G. Costomediastinal indurations. *Fortschr. a. d. Geb. d. Roentgenstrahlen*, 1923, xxxi, 165.

Costomediastinal indurations are often put under the head of pleuritis mediastinalis. It is, however, not an inflammatory process. Generally it is not strictly localized between the pleura and the mediastinum. The condition in the roentgenogram will cause a homogeneous shadow which is closely related to the central shadow. Where the rays extend in the sagittal direction, the shadow of the exudate is paramediastinal, intracardiac or para-vertebral. According to Savy, there is an anterior and a posterior (retrocardiac) pleuritis mediastinalis. It is generally found in the lower section of the thorax, and in some instances in the upper part, either on the right or left side, and only exceptionally is bilateral. The shape of the roentgen shadow is influenced by location and size of the exudate. Small exudates in the anterior pericardial pleura do not reach beyond the cardiac border shadow, and therefore may escape notice (Lorey). An anterior mediastinal pleuritis of medium extent forms a shadow parallel to the cardiac shadow, so to speak, doubling the latter. When the exudate increases, a triangle forms with its base downward, filling the cardio-diaphragmatic angle. The presence of air or gas (pyopneumothorax mediastinalis) blunts the apex of the triangle, even converting it into a horizontal line. When the exudate forms above and in front it will often cause a band-shaped shadow. Posterior mediastinal pleuritis will sometimes cause a para-vertebral shadow, or may be seen as a triangle which is distinguishable through the cardiac shadow. Groedel saw an almost sac-shaped contra-lateral horizontal shadow in a high retro-cardial exudate of the right side.

The lateral border of the shadow of the exudate is straight, convex, or concave, and mostly smooth. In one of Groedel's cases the shadow was notched.

Differentiation between costomediastinal and mediastinal indurations must be made on the basis of the anatomical location of the substratum of the roentgenological demonstrable shadow. The mediastinal shadows are seen in the mediastinal cleft proper, the costomediastinal at the costomediastinal sinus. Costomediastinal indurations are not uncommon. Generally they are the consequence of serous or fibrinous pleuritis of the sinus, mostly of tuberculous, more rarely of metapneumonic nature. The clinical signs of the costomediastinal indurations are not characteristic. They may cause more or less severe discomfort. In other instances they remain without symptoms.

Frontal roentgenograms will not show up the costomediastinal indurations. Basal indurations are hard to differentiate in the left anterior sinus from mediastinal adhesions on the cardiac surface. Mostly costomediastinal adhesions are combined with true mediastinal adhesions. This combination generally escapes the roentgenological plate.

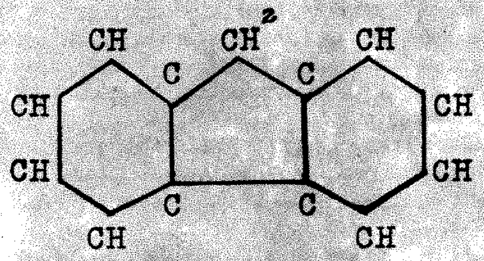
JAUBERT, M. A. de Beaujeu. Researches on the luminescence by roentgen rays. *Le Jour. de Phys. et le Radium*, Aug., 1923, S. vi, v. iv, 257–267.

A certain number of solid dissolutions of rare earths were prepared after the method of Tubain and Brüningshaus, from which were obtained with roentgen-ray spectra luminescence composed of rays and bands, comparable in every way with cathode spectra. They differed in the number of rays with cathode spectra. They differed in the number of rays and bands which they revealed.

The energy of the roentgen ray was more feeble than that of the cathode ray. The material employed, was not as pure as that of Tubain and Brüningshaus.

Most beautiful fluorescence was obtained with double salts of uranium dioxide.

The platino-cyanides of ammonia, rubidium, lithium, barium, potassium, thorium and magnesium, gave a continuous spectrum. A series of compound phosphorescent sulphides, prepared by the method of Lenard and Klatt, gave continuous spectra.



The literature of roentgen-luminescence for organic bodies is very meager. The luminescence of some organic bodies has been known since the discovery of the ray, but there has been no systematic research. At first, it was proposed to make a fluorescent screen with "Pentadecylparatolycétone."

But this substance which lights up with the cathode ray, does not light at all with the roentgen ray, as Precht affirmed in his two reports.

Systematic examination was made of as large a number as possible of organic solids, classifying them by chemical formulae. Here, as in mineral substances, the employment of a bulb of Lindemann glass has its importance, because a large number of organic preparations which shine very little with the ordinary bulb, become very luminous with this bulb.

Only solid bodies were examined; the spectra were taken with the direct vision instrument of Hilger. The ultraviolet spectrum was not examined. It is necessary to pass from 5 to 12 ma. into the bulb to get sufficient intensity of ray.

A study was made of several of the condensed ring carbides and some of their derivatives, fluorine anthracine, etc. All of these carbides are remarkable for the fluorescence which is easily caused by the roentgen ray. The least brilliant is naphthaline

Chemically pure fluoréne shines with an intense violet brilliancy under the influence of roentgen ray. The emitted light is a blue violet and presents a characteristic spectrum. Rélène, one of the higher homologues of anthracene, when purified, lights up with an intense blue green; when chemically pure, it lights up a clean screen with an intense blue violet, more or less similar to that of anthracene, which itself, gives an intense blue violet.

Conclusions: 1. There are a large number of solid organic substances which can be rendered fluorescent by the roentgen ray.

2. The aromatic substances are the most fluorescent and it is concluded that the benzene ring is the principal fluorophore.

3. The degree of purity influences greatly the luminescence; the purer the material the more brilliant the light.

Landau, W. Neurogenous disturbances of deglutition accompanied by entry of the contrast medium into the respiratory tract shown in the roentgenogram. *Fortschr. a. d. Geb. d. Roentgenstrahlen*, 1923, xxxi, 291.

When a man, aged 44, was examined for intestinal disturbances the contrast medium was seen to form a peg-shaped protrusion, posteriorly on the level of the bifurcation of the esophagus. It disappeared quickly, and suggested a diverticulum. Soon after, however, branched bands were seen in the retrocardial field, which, upon posterior examination, were recognized as bronchial branches in the lower lobe of the lung. Trachea and larynx were likewise well outlined. The patient did not cough till several minutes later, though he had a history of pneumonia and pleuritis and was suffering from indurating pulmonary tuberculosis, and the heart was displaced by pleural adhesions. He later said that he avoided fluids on account of their regurgitation through the nose. Evidently the coordination of the deglutition process was defective. A slight weakness of the right lower part of the facial nerve existed. The gagging reflex was diminished. An old focus of chorioretinitis was found in the right eye, and the sympathetic showed a paresis. The diagnosis of congenital syphilis was made on the basis of ocular findings. The defective deglutition was probably due to a vagus paresis of luetic origin.

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STUDIES OF THE COLON

BY R. WALTER MILLS, M.D., AND HORACE W. SOPER, M.D.
ST. LOUIS, MISSOURI

I

ROENTGEN-RAY EVIDENCE OF COLONIC SECONDARY CHANGES*

BY R. WALTER MILLS, M.D.
ST. LOUIS, MISSOURI

IT seems unfortunate that much medical evidence of interest leading to deductions of value fails of general appreciation because it does not lend itself to presentation and prescribed scientific form. By the time observations on a bewildering amount of complex evidence are boiled down in desiccated form—defensively suitable for ritualistic 15 minute administration, they have been so deleted and overtooled that they have lost a large part of their practical value and certainly most of the charm that made their collection a satisfying pleasure.

Much of value is not possible of statistical arrangement or proof by figures. Again different causative factors may result in a common type of reaction only possible of utility through the interpretation of other evidence; a situation that does not make for effective scientific presentation or conviction, but of great value nevertheless.

One of the hardest things that blocks progress is that often intangible evidence, not lending itself to verbal description or the approved type of formal presentation, must be largely lost or at least be far delayed in recognition. Who can describe the subtle change in the sick man's face, the color of the skin, the quality of the voice, the slight change in mental attitude. How can we visualize and verify for others the delicate variations in a roentgenogram of equally definite portent. Certainly not by any of the usual procedures of formal presentation of the chemical laboratory type. We are approximating art—the reactions of the sensibilities not possible of immediate transmission to others and to be acquired only through the language of the sensibilities cultured by experience.

Because of such facts we must acquire through personal contact a not inconsiderable portion of our medical attitude. The clinic, the plate demonstration, the personal visits, the conversations with friends of like interest, are the only accepted conventions. Is this not regrettable? It is certainly highly limiting. It seems undesirable that a too protective ritual should be allowed to deflect possible ends of progress. Admitting the wisdom of such regulations generally we should certainly have sufficient flexibility to modify our forms as changing conditions indicate that it is best.

May I present the outline of an effort much of which I freely grant is not altogether capable of proof along usual lines, and possibly not untempered with imagination as to future possibilities, but which I hope may be of interest to others in their work and especially in problems that they may have under consideration.

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* Read by invitation at the Twenty-third Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923. Material from the private laboratory of Dr. H. W. Soper and myself and the X-Ray Laboratory of Washington University Medical Department.

It would seem that our attitude towards the problem of certain colonic conditions in common with other portions of the gastro-intestinal tract is destined to undergo a considerable change in the not distant future. This through recent physiological investigations, such as the determination of gradients, the promise of light on the mechanism of alimentary motility and through the probable and greatly to be hoped for development of the roentgen ray as a means of physiological investigation.

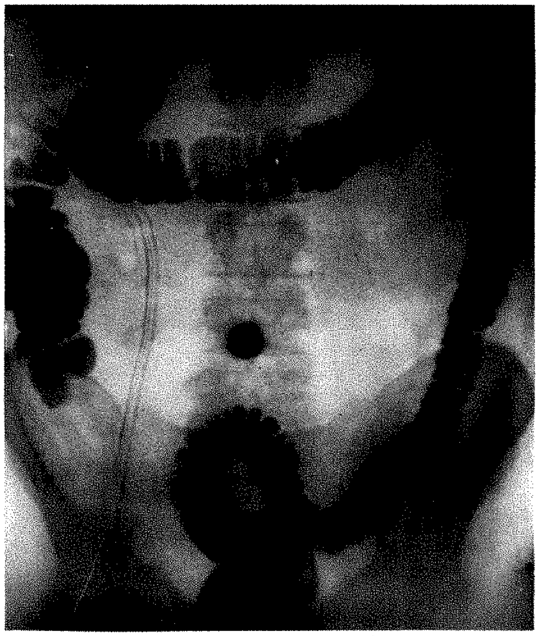


FIG. 1. Normal colon of subject of hypersthenic habitus. Colon generally high in position, cecum well out of iliac basin, transverse colon truly transverse, descending colon proportionately long and straight, pelvic colon even rises out of pelvis. Marked colonic tonus, rapid motility, and fine numerous haustration.

Heretofore we have been concerned with evidence of gross pathological changes and generally attracted by the great immediate practical diagnostic aid which the roentgen ray affords. It seems that a great outlet may lie in the opportunity of obtaining evidence of other conditions largely through changes secondarily occurring in the viscera—evidence available in a far larger proportion of cases, and of great value because usually indicating remediable conditions, which the organic lesions too frequently are not. The great and future interest lies not in such soul-satisfying rudiments as filling defects but in the vast world of physiological reactions and anatomical and functional variations and changes.

My proposition is that the abdominal viscera, taking the colon as an example peculiarly fitted for such purpose, may in their form and topography and especially through their contractural reactions give secondary evidence of many primary conditions not themselves otherwise possible of appreciation, and that certain anatomical and physiological variations seem, to say the least, associated with certain abnormalities of function. Perhaps it is true that the colon something after the fashion of the stomach less frequently has anything the matter with it, than that it is secondarily affected by extracolonic conditions or perversions of its function.

The difficult matter of an appreciation of a normal colon is necessary before we can reach conclusions: of its great variability in topography, form, length, tonus, contractural reactions and motility and of its general relation as to such, to bodily habitus; that every static peculiarity of the individual finds its reflection in the topography and form of the colon through resulting determination of abdominal regional capacities, proportions and distances; that all individual colonic peculiarities are influenced by the form, proportions, dimensions and pressure of the other organs of the abdomen, facts in turn true of every other abdominal viscus; and that the colon is individual in each person (Figs. 1, 2, 3, and 4).

The subject is such that it is almost impossible to review it effectively in abstract form. May I ask your indulgence in presenting it only suggestively through certain propositions and as an outline schema, and later by the illustration of certain of the points with slides, promising to illustrate more fully and to submit such statistics as are possible in its publication.

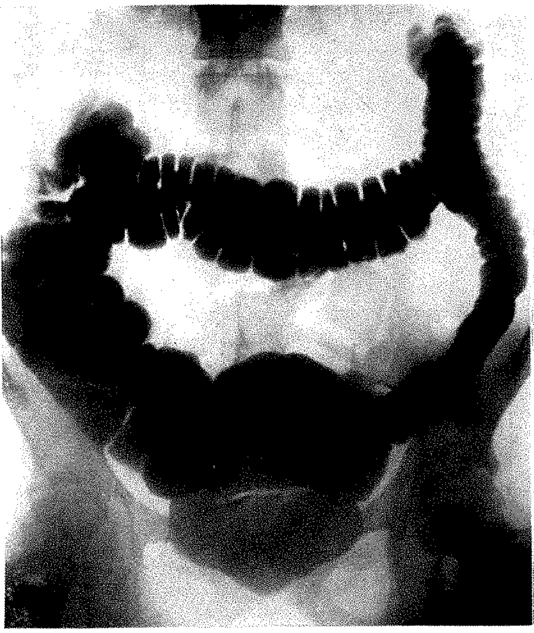


Fig. 2. Normal colon of subject of asthenic habitus. Colon low in wide and capacious pelvis. Tonus poor, motility slowest of any type and haustration coarse.

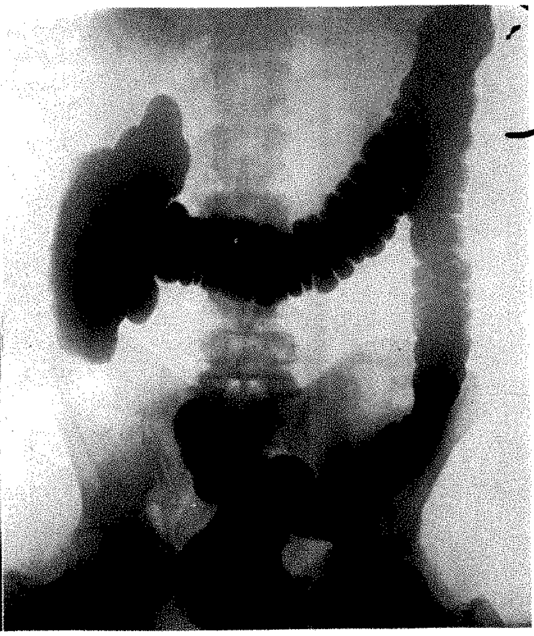


Fig. 3. Normal colon of subject of sthenic habitus. Characteristics those of the hypersthenic type but less marked. Capacious upper abdomen housing the high digestive plant. Less degree of tonus than the hypersthenic, less rapid motility, and coarser and less frequent haustration.

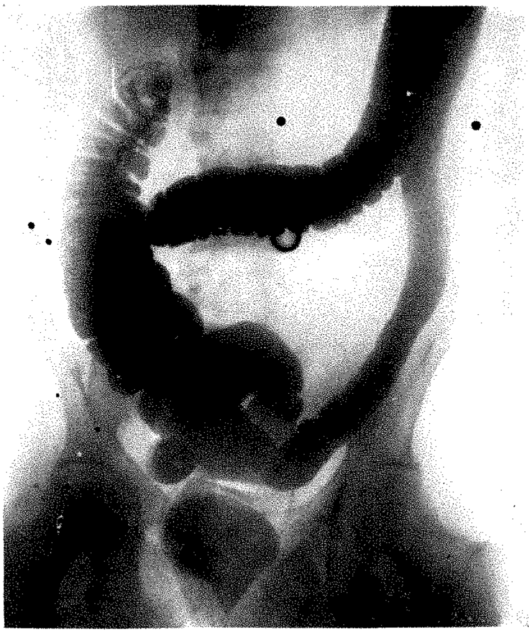


Fig. 4. Normal colon of subject of hyposthenic habitus. Intermediate between the sthenic and asthenic. The small pelvis makes for a higher colonic position than in the asthenic. Tonus moderate only, motility rate average, and haustration rather coarse.

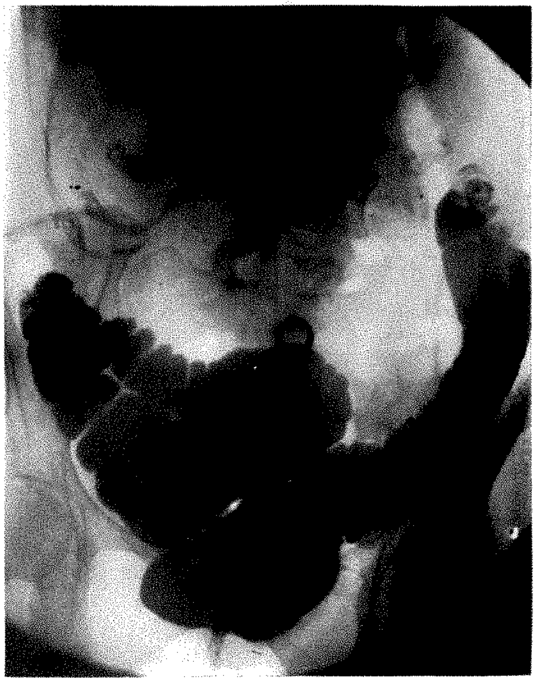


Fig. 5. Low colonic topography determined by marked right lateral thoracic and left lateral lower thoracic and upper lumbar spinal curvature modifying regional abdominal capacities.

It seems obvious that any acquired malstatic state, spinal curvatures, list or pelvic axial deviation will influence colonic topography (Figs. 5 and 6). I cannot but revolt at the idea of a colon ptosis, *per se*, as a symptomful entity. It is largely but a resulting reflection of not admirable statics determining a low colonic topography in common generally, with that of all the abdominal viscera, its form modified by the resulting modification of regional abdominal capacities. By far the most common determinant of any visceral ptosis is spinal curvature. Relief by support is not improbably the relief of secondary static strains.

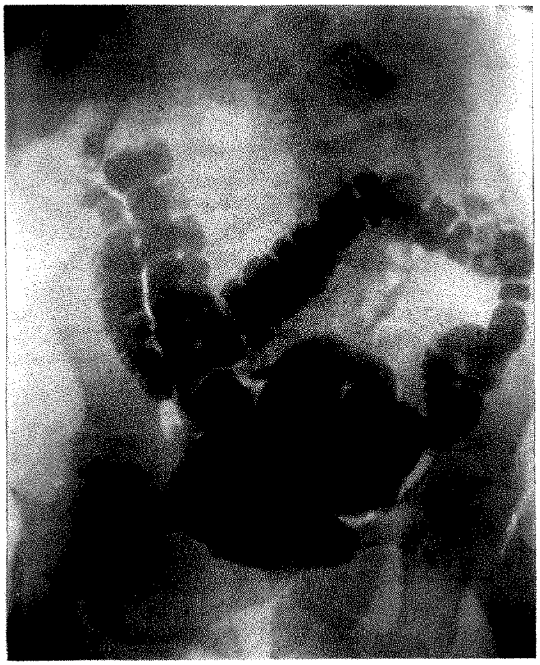
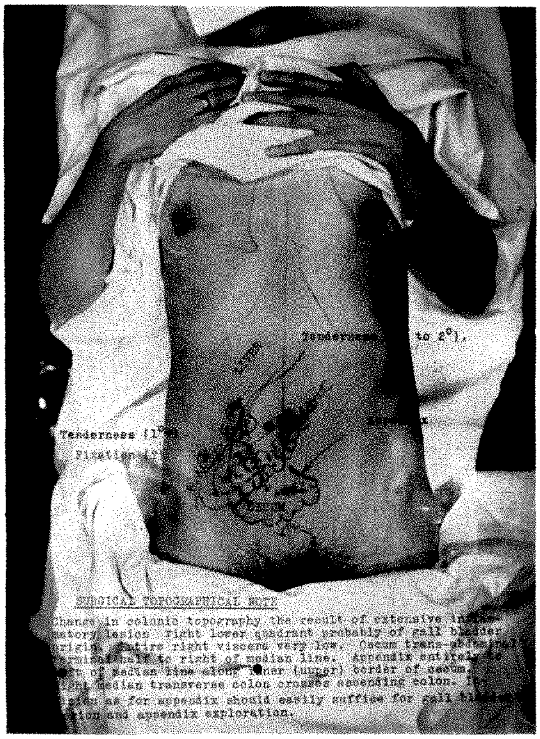


FIG. 6. Malposition of colon in response to most marked right lateral thoracic spinal curvature.

It is obvious that any extra-alimentary tumor or great enlargement of an organ or considerable exudate, must influence the topography of the colon: but it is equally true that similar less marked factors do so, even when otherwise not giving evidence of their presence (Figs. 7 and 8).

It seems probable that certain individual static and osseous structural peculiarities may influence to abnormalities of function, in turn with resulting changes in form. That a narrow pelvis determining a vertical rectum and pelvic colon may, through resulting strain on the pelvirectal sphincter, be a primary factor in developing its acquired patulence with resulting functional disturbance—the peculiar type of constipation associated (Figs. 9, 10, and 11).

There is evidence to suggest that great numbers of alimentary and extra-alimentary lesions, and products of lesions, simulate certain secondary physiological colonic reactions giving roentgen-ray evidence of their occurrence. For instance that the mere contact of an extra-alimentary exudate or tumor, modifies the local form of the colon through stimulation of secondary reactional contractures, even without other evidence of its presence—and with



SURGICAL TOPOGRAPHICAL NOTE

Change in colonic topography the result of extensive in
atory lesion right lower quadrant probably of gall bladder
origin. Entire right viscera very low. Cecum trans-abdominal
[illegible] to right of median line. Appendix entirely
[illegible] of median line along inner (upper) border of cecum.
[illegible] median transverse colon crosses ascending colon.
[illegible] as for appendix should easily suffice for gall
[illegible] and appendix exploration.

FIG. 7. See surgical topographical note on photograph describing colonic changes. This method of recording and studying individual visceral topography consists essentially of the photography of the recumbent patient by means of a camera attached to the ceiling and with a sheet of glass on which are orthodiagraphic tracings lying on the patient's abdomen and so interposed between his body and the camera. The visceral outlines are on the sheet of glass, but glass being transparent, if arranged in certain fashion is not apparent; the lines on the glass appearing as though marked on the body.

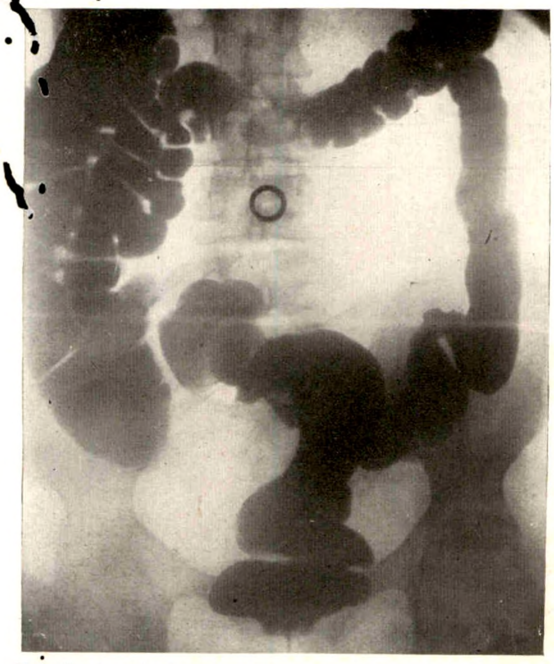


FIG. 8. Atypical topography and form of pelvic colon influenced by extra-alimentary tumor in this instance a unilocular cystic right ovary. Operative confirmation.

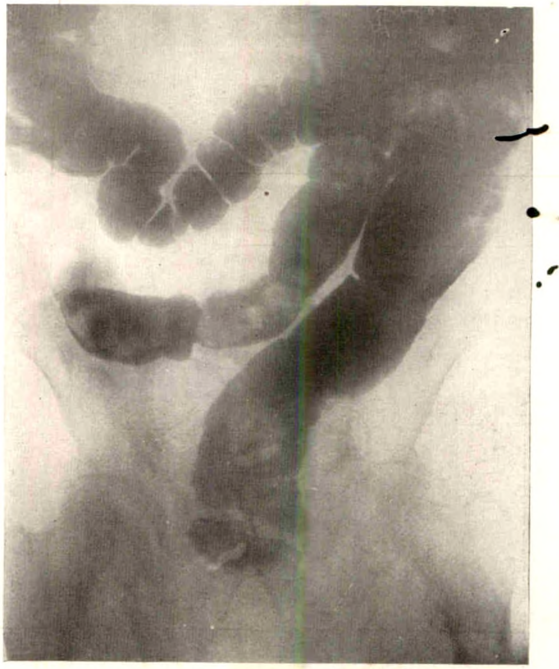


FIG. 9. Marked colonic redundancy of unusual type indicating adjustment of colonic topography to abdominal regional capacities. Exceedingly narrow pelvis through resulting strain on pelvirectal sphincter possibly influencing patulous recto-sigmoid.

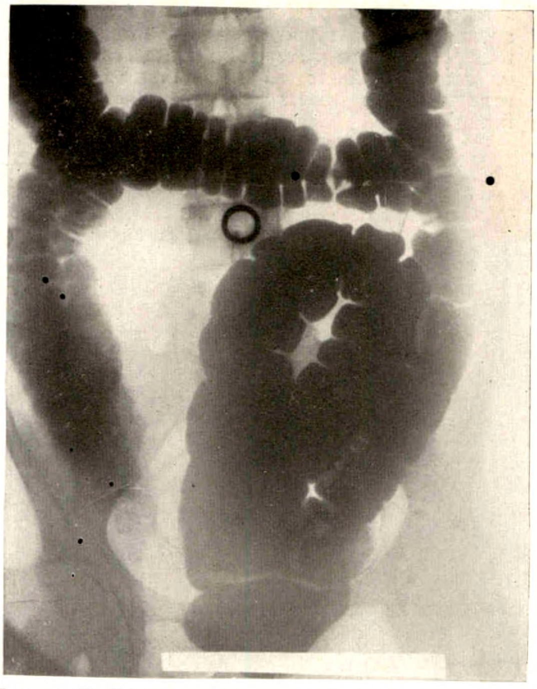


FIG. 10. Striking patulous recto-sigmoid—type seen in male hypersthenics. Patient, woman of 27 years weighing 127 lbs., of hyposthenic habitus. Illustrates probability that narrow pelvis determines atypical topography of pelvic colon.

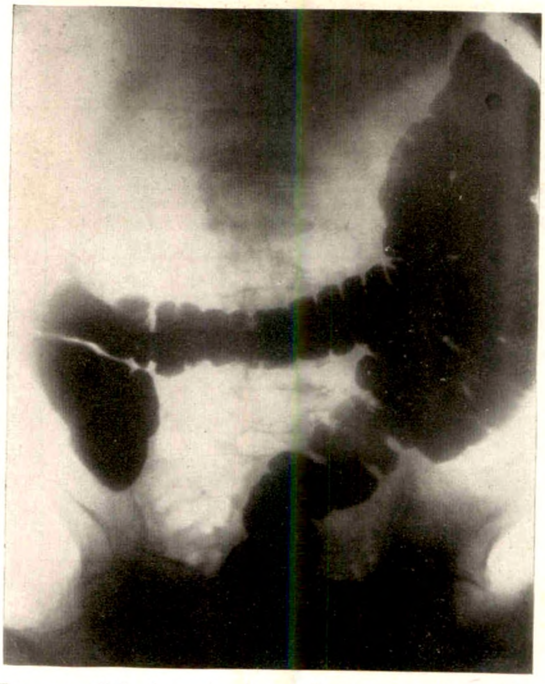


FIG. 11. Colonic redundancy limited to descending and iliac colons, possibly result of statics. Note spinal curvature and extraordinary shallow pelvis. Proximal colon depressed by enlarged liver.

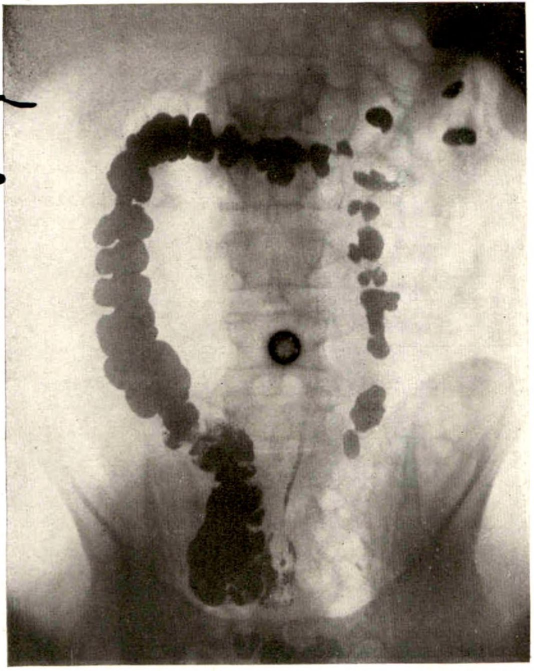


Fig. 12. Change in form and position of abdominal viscera. Appendix very low, apparently in mid line between umbilicus and pubis. Cecum very low, approximates mid line (full sthenic habitus). Exudative peritonitis of appendicular origin, cecum adherent, appendix densely adherent. Operative confirmation.

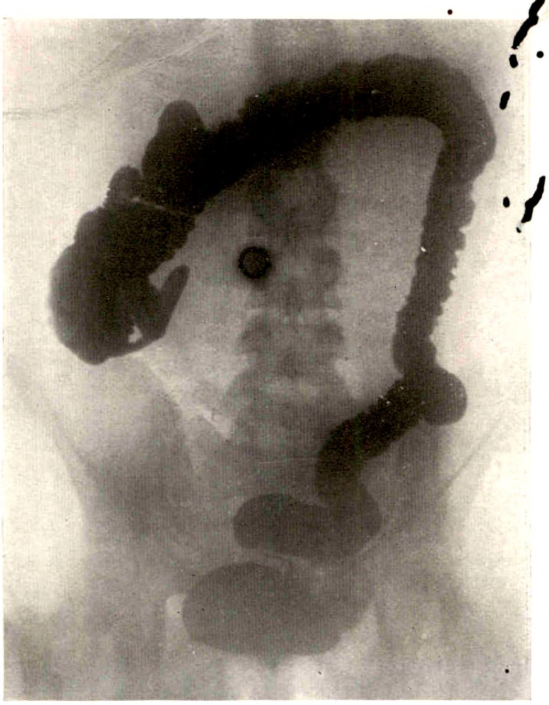


Fig. 13. Illustrating serration type of haustration ascending, descending, and iliac colons, and less marked transverse colon stimulated by multilocular right ovarian cyst which perforated. Peritoneum contained about two gallons of thick yellowish syrupy fluid. Atypical topography of entire colon apparently dislocated centrally throughout, as though by traction. Appendix dilated as the result of secondary increased intra-abdominal tension resulting from tumor pressure. Operative confirmation.

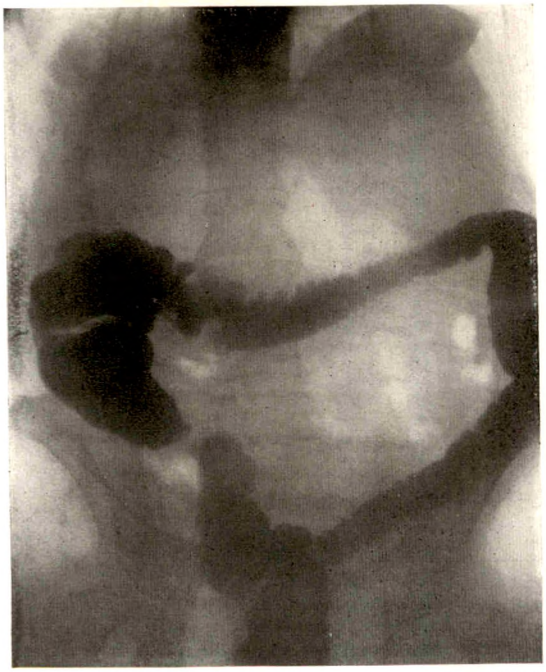


Fig. 14. Strikingly atypical transverse colon, "irritation forms," resulting from carcinomatous involvement of mesentery probably originating in ascending colon. Bloody ascitic fluid present Operative confirmation.

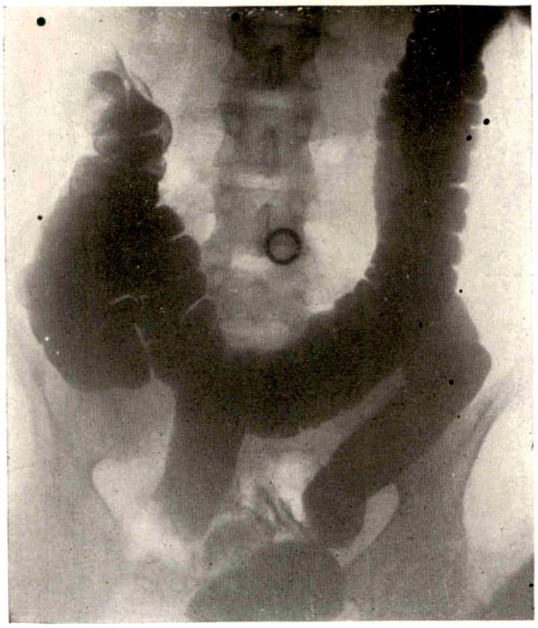


Fig. 15. Extra-alimentary tumor modifying form of transverse colon. Operation revealed "retro-peritoneal tumor springing from posterior abdominal wall, growing out between layers of mesentery, probably sarcoma."

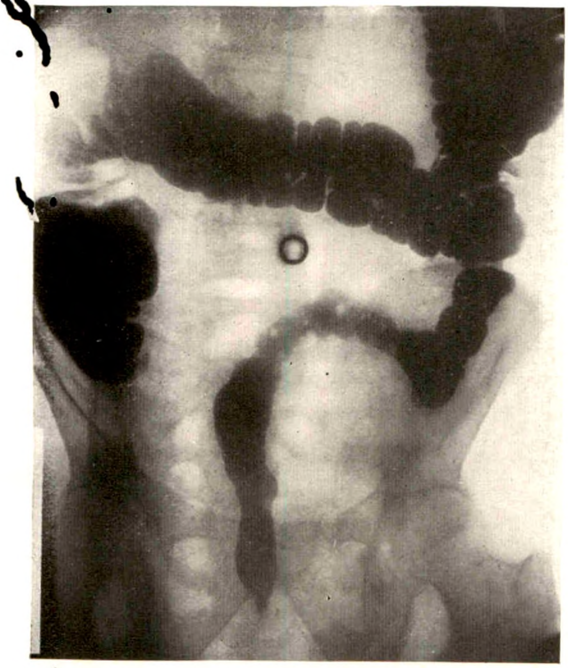


FIG. 16. Striking change in topography and contour of distal colon due to extra-alimentary tumor. Operation revealed pelvic colon, sigmoid and rectum surrounded by dense masses of fat. Microscopical: chronic inflammatory disease.

hesitancy that something of the nature of the lesion can probably with added experience be anticipated from the type of reaction. Personally I never use belladonna to inhibit spasm which may be of much diagnostic helpfulness. In an ascites the colon may be obviously changed in topography and form through actual dislocation and especially lack of those supportive extra-colonic visceral pressure factors normally influencing. But there is also evinced actual shortening of the colon and peculiar tonal changes suggesting irritation by the ascitic fluid. A local colonic diverticulosis may be anticipated, though not immediately apparent, by the resulting atypical haustration and contractures (Figs. 12, 13, 14, 15, 16, 17, 18, 19, and 20).

It is plain that any considerable pathological lesion of the colon may influence its general form, as for example an exudative colitis, but it is suggested that we may have indication of such conditions as the non-exudative colitides through secondary contractural modification of form (Figs. 21, 22, and 23).

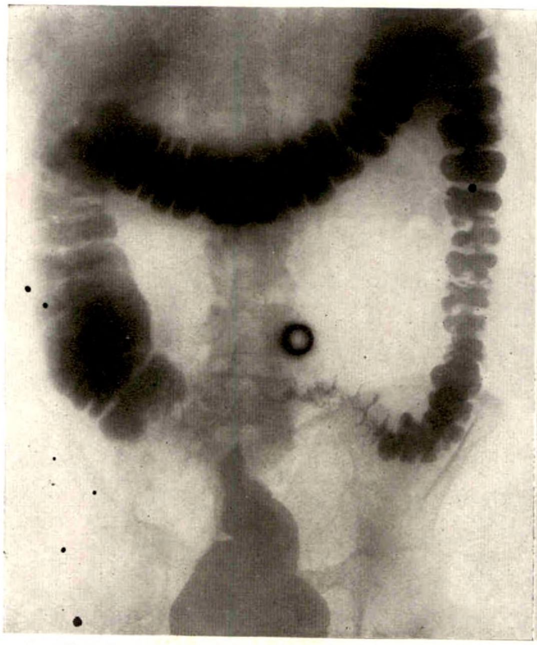


FIG. 17. Carcinoma of sigmoid originating in wall of bowel and growing externally in such a manner as to embrace the colon. Compare with following figure—same case seven weeks later. Ascites present. Extreme spasticity of entire pelvic colon—unusual and striking. In conjunction sigmoidoscopic findings negative. Operative confirmation.

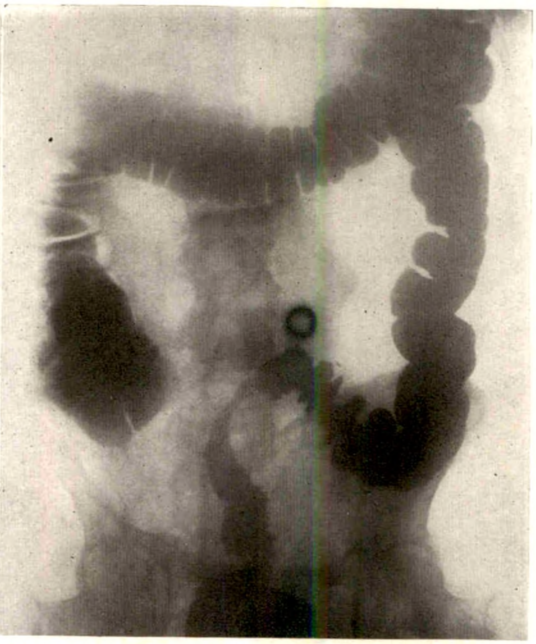


FIG. 18. Contour defect involving proximal pelvic colon and extending as irregular spasticities of striking character to iliac colon and proximal half (?) of rectum. Defect in median pelvic colon suggestive of neoplasm. Irritation reactions entire proximal half of rectum and atypical striking disorderly haustration distal half pelvic colon. Compare with preceding figure—same case.

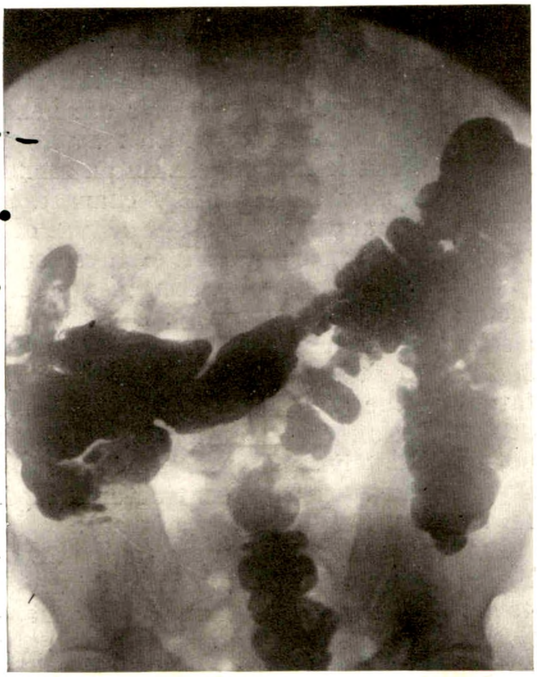


Fig. 19. Postoperative examination (resection for carcinoma proximal transverse colon). Most marked abnormalitity in form of colon, without haustral markings. Inhibited motility?

There is a vast deal to be learned as to colonic contractures as expressed by colonic rugae, perhaps mucosal movements, as recently suggested by Forssell, of which there seem several distinct types; especially a lateral non-haustral canalicular, a general poly-directional haustral, and a longitudinal haustral compression sort. In time it seems possible that we may judge by the roentgen ray of abnormal changes in the colonic mucosa just as we can now of the stomach as when contiguous to a gastric ulcer through abnormally directed rugae, and in certain cases of gastritis (Figs. 43, 44, and 45).

It would seem possible that certain abnormalities in colonic function in turn result in secondary visual changes in form —witness the patulous rectosigmoid that we consider the result of divulsion through rectal fecal retention with its secondary contiguous colonic dilatation, highly characteristic on the plate.

We cannot know as yet that such conditions really are anatomical changes the result of mal-function; the patulous recto-

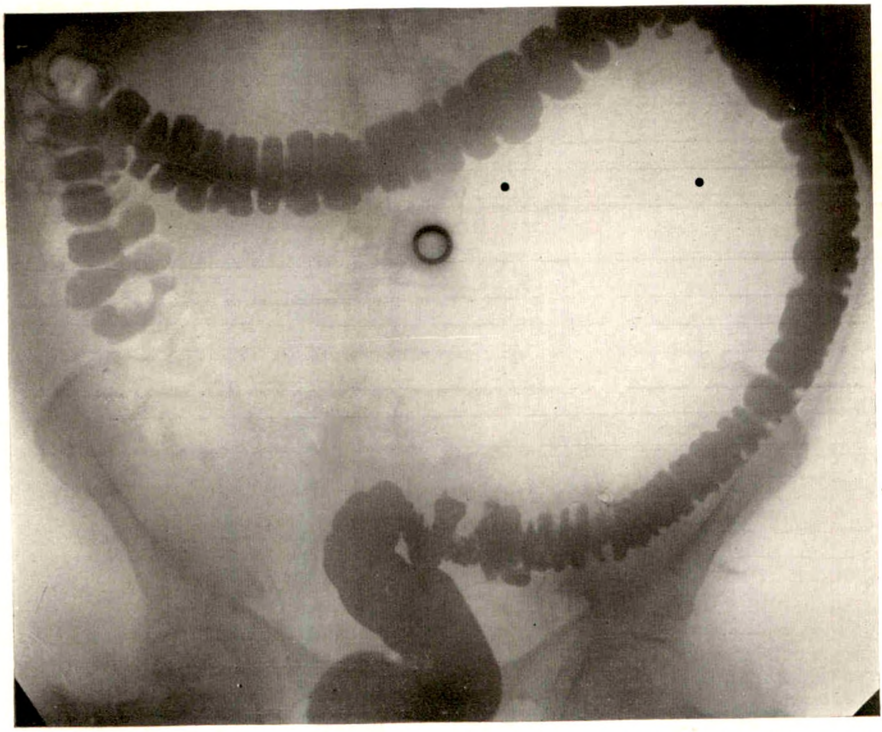


Fig. 20. Case of multiple colonic diverticulosis distal iliac and pelvic colons. Diverticula anticipated by the atypical contractural reactive haustration contiguous to diverticula and irritation colonic "fibrillation" iliac colon. Diverticula also apparent inner surface splenic flexure.

sigmoid may occur early in life, but there are reasons to judge that this is improbable. There are certainly implied analogies through the fact that other sphincters such as the pylorus and cardia may be observed to become patulous under similar intra-alimentary hypertension of contents, as in carcinoma of the stomach. In constipation may not extreme colonic hypotonicity or hypertonicity, be in certain instances reactional, especially when disharmonic on the basis of bodily habitus.

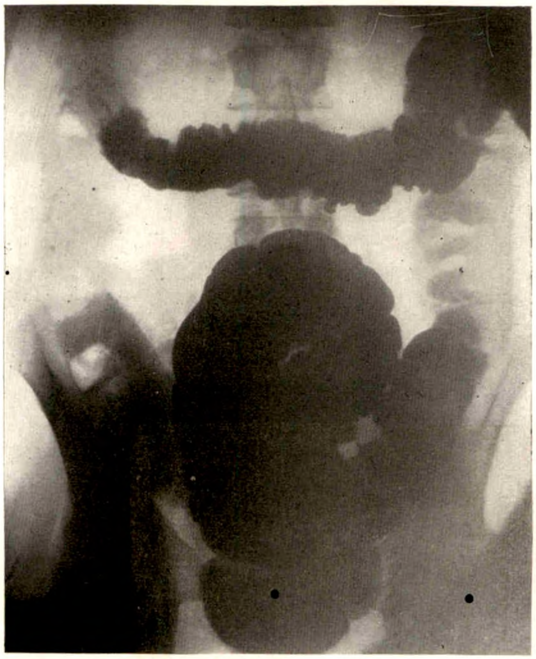


FIG. 21. Irregularities in contour of transverse colon of serration type without definite haustral markings. Case of ulcerative tuberculous colitis. Note filling defect entire cecum.

Certainly the very look of the colon in constipation seems characteristic. May not a redundant colon be sometimes in some way acquired, admitting wide variation in the normal. Granted that it may occur in early infancy or congenitally—so does Hirschsprung's disease and congenital pyloric stenosis. Why should the longitudinal bands of the colon not be stretched under certain conditions or in response to certain pressure conditions in a fashion analogous to the stretching of the colonic muscle fibers before birth in Hirschsprung's disease. There is reason to believe that the longitudinal bands have a physiological contractural colon shortening haustral compression function, and there is no reason to believe that they might not be stretched under strain as may any other similar tissue. It is curious that, if the length of the colon is a congenital peculiarity, it is over 100 per cent the most variable organ in the body. This on John Bryant's investigation. The fact that the redundant colon bears no relation to bodily type is interrogating; also that localized redundancies seem predilected to those locally increased abdominal regional capacities resulting from malstatic states or individual structural peculiarities—as though there determined by resulting relative decrease in extra-colonic pressure support by the extra-colonic viscera; furthermore that the incidence of redundancy is apparently higher in such subjects. Certainly a possibly predisposing pressure factor is present in practically all cases of colonic redundancy through the associated constipation. The relationship of constipation to redundancy is very definite and striking. We may ask these ques-

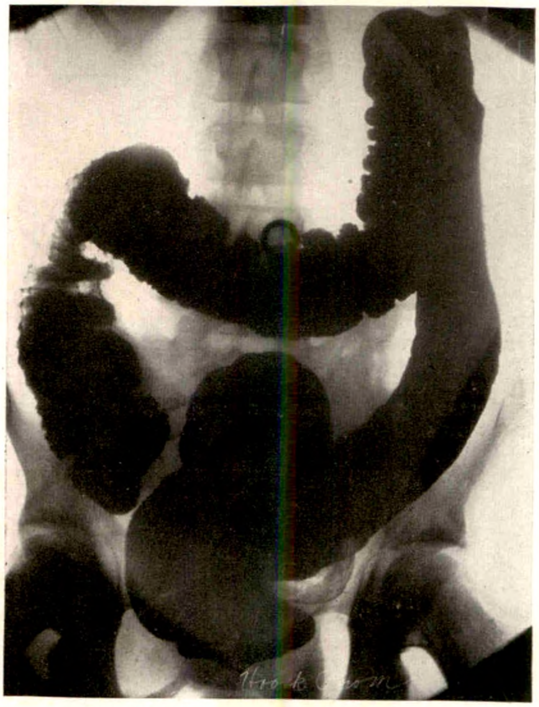


FIG. 22. Striking, fine, serration-like reactive outlines ascending and transverse colons definitely suggest peritoneal irritation secondary to tuberculous colitis. Terminal pulmonary tuberculosis.

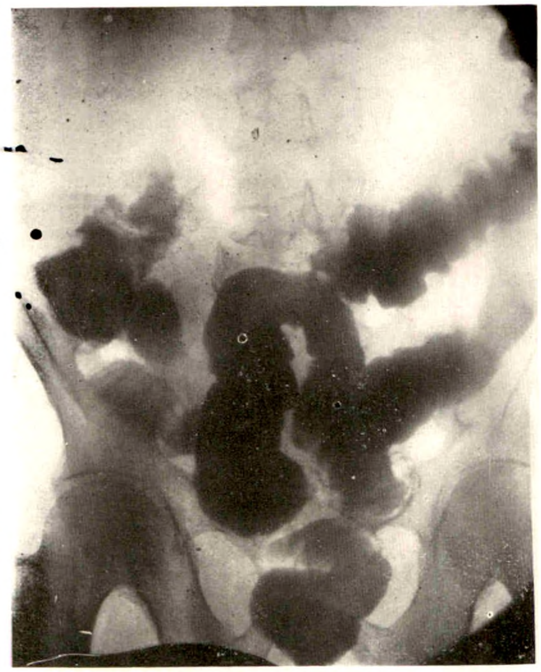


FIG. 23. Atypical contour and atypical haustration entire colon, general, disorderly irregularities highly suggestive of colitis or secondary colonic involvement. Autopsy revealed spindle cell sarcoma of colon with metastasis, pseudomembranous colitis, and localized peritonitis.

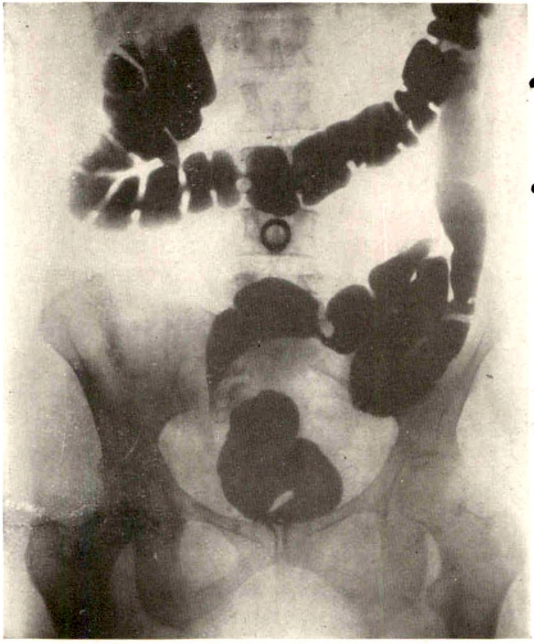


FIG. 24.* Atypical dislocation of iliac colon upward and of pelvic colon to right and upward. Two months' pregnancy.

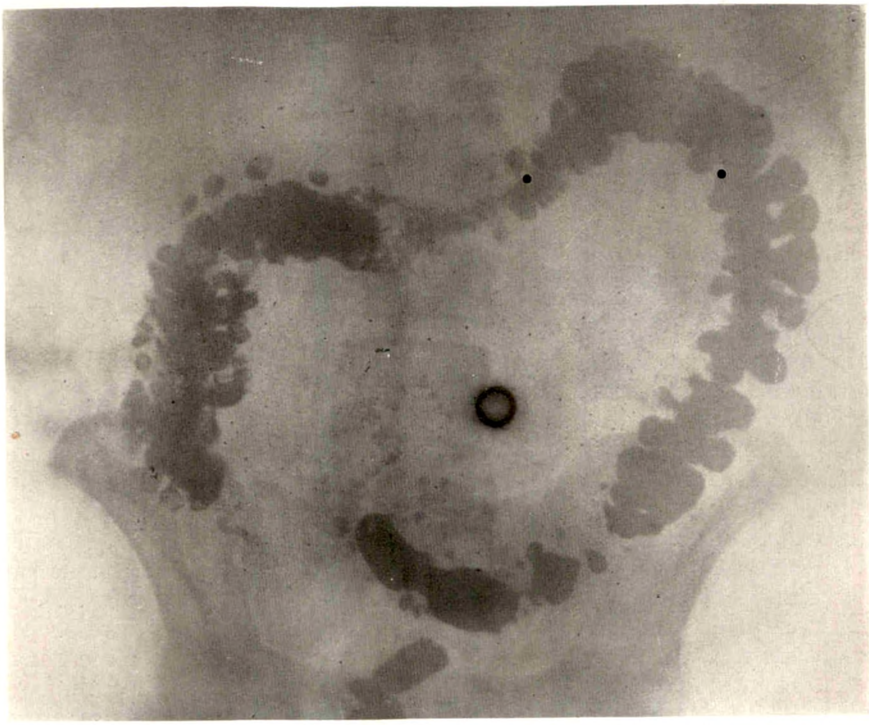


FIG. 25. Case of multiple colonic diverticulosis. Extraordinary number of large sized diverticula entire colon, striking of cecum and ascending colon. Entire colon seems curiously shortened.

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* FIGS. 24–42 are not directly referred to in the text but further illustrate points mentioned.

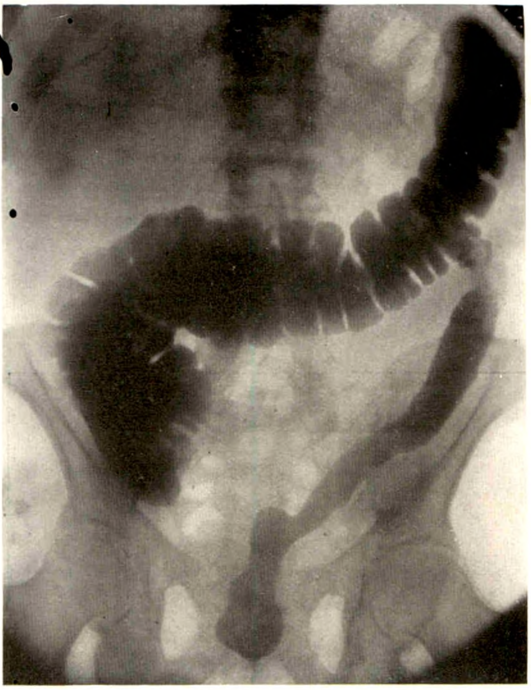

Fig. 26. Striking lack of canalization entire distal descending, iliac, and pelvic colons. Rectum also strikingly diminished in capacity and of atypical tubular-like form. Findings highly characteristic of exudative colitis, i.e. distal colon reduced to stiff tube and shortened.

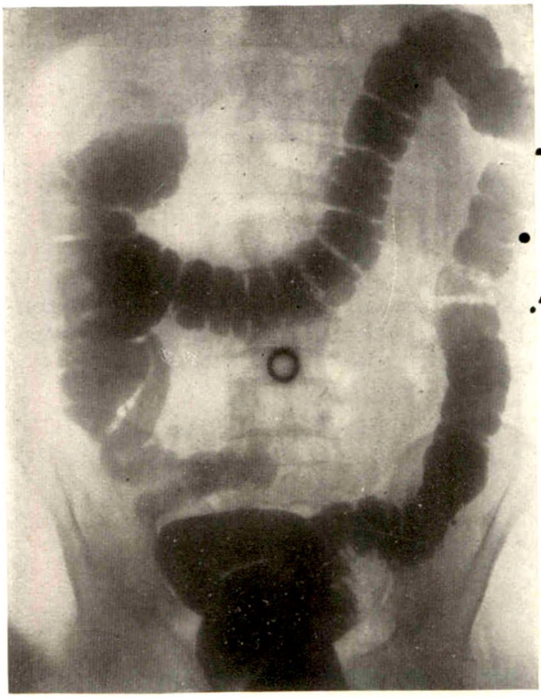

Fig. 27. Colonic diverticulosis definitely and curiously limited to distal iliac and possibly proximal pelvic colons. Colon of not great tonus, somewhat hypotonic considering type of individual; only suggestion of spasticity in portion of iliac colon—seat of diverticulosis.

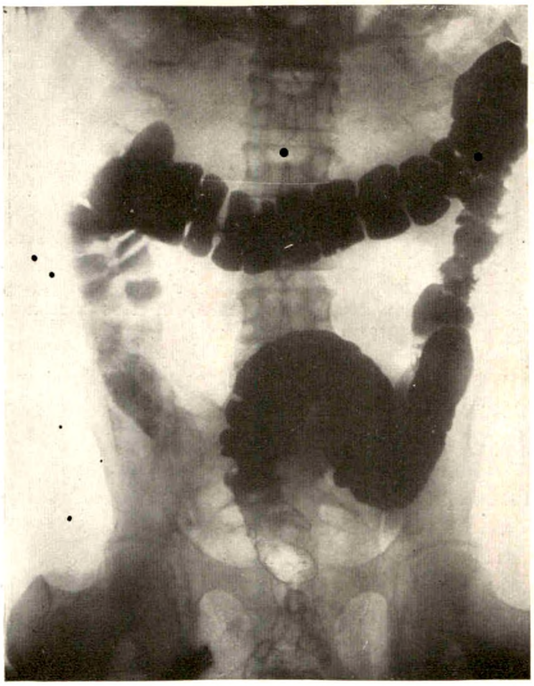

Fig. 28. Case of polypoid growths producing stenosis of the rectum and pelvic colon (papilloma). Secondary irritation serration type of haustration descending colon. Operative confirmation.

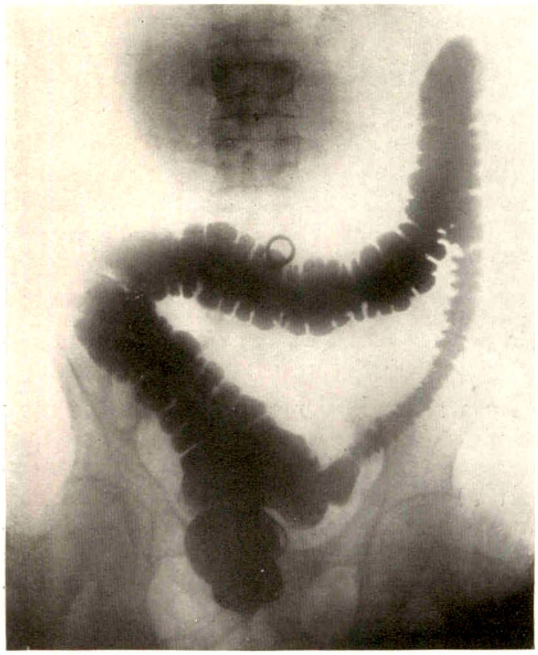

Fig. 29. Case of ulcer of rectum producing secondary irritation spasticities of the descending and iliac colons.

tions; they are impossible of solution at present.

The problem of secondary intracolonic hypertension resulting from redundancy, if such may be a secondarily acquired change, and other resistance causing factors, is a chapter in itself. Such hypertension seems much concerned in the general and local discomfort characteristic of redundant constipation; also in such conditions as colica mucosa and continued postoperative pain.

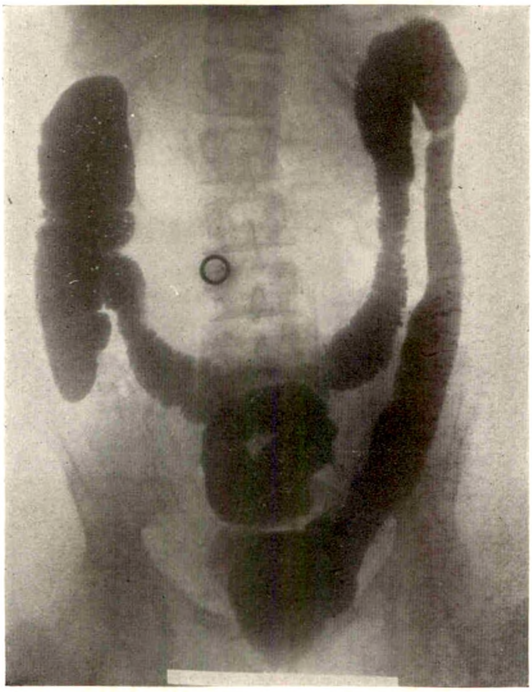

Fig. 30. Atypical haustration entire colon in a case of sprue (active diarrhea). At no point normal haustration, colon essentially unhaustrated. Irritation spasticities practically entire transverse colon and rectum. Spasticities of fine serration suggesting irritation in colonic wall rather than due to extracolonic factor.

As a secondary motor disturbance may be mentioned the apparently curious fact that colonic motility in common with general alimentary motility is increased in rate when any space occupying extra-alimentary tumor is present—perhaps through secondary stimulation of peristalsis plus increase in intracolonic tension.

The whole vast subject of constipation, by far the commonest of all diseases, whose seriousness grows on us as we consider it, is open to and will richly reward roentgen-ray investigation. It seems strange that there are tomes written on the composition of the fat molecule and but comparatively little, based on modern roentgen-ray methods of investigation, on the most frequent disease that affects mankind.

At the last meeting of the American Gastro-Enterological Association my associate, Dr. Soper, submitted a classification of types of constipation resulting from our work with combined roentgen ray, proto-

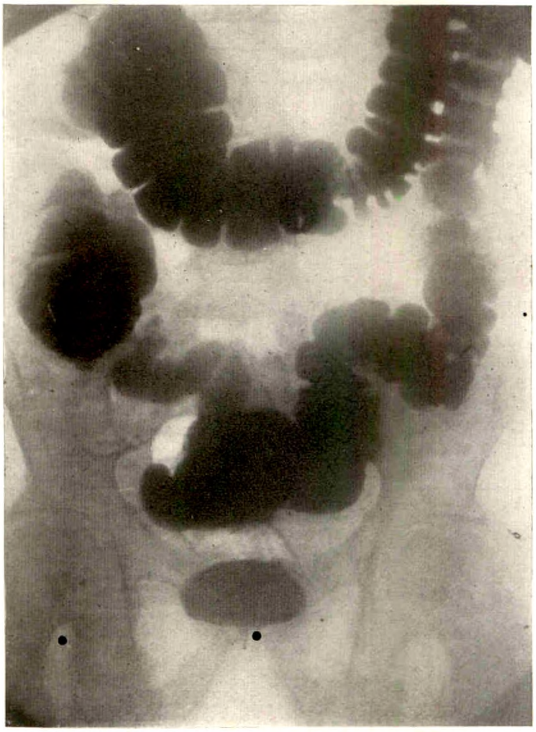

Fig. 31. Atypical haustration distal transverse, descending, and iliac colons. Peculiar sharp haustration suggestive of colonic irritation, in this instance, amebic dysentery.

sigmoidoscopy, clinical and laboratory observations and results of prolonged treatment; this on the experience of years with thousands of cases. Due to information thus obtained a very different classification was evolved from the old spastic and atonic types. This classification is based essentially on contractural and hypotonic changes, local rather than general, and usually disharmonic in different portions of the colon. These we ever in the end find ourselves forced to suspicion as secondary to a primarily perverted function plus irritation resulting from abuse

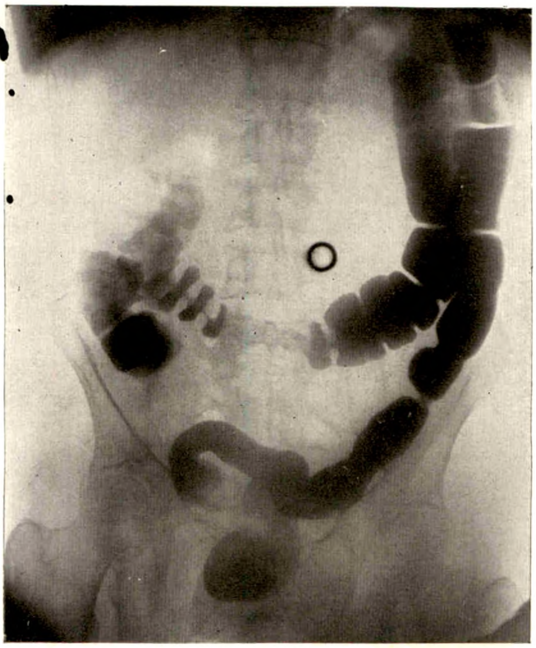

FIG. 32. Atypical and deficient haustration of iliac and pelvic colons. Rectum of atypical contour and contracted. Disharmonic colonic tonus—local spasticities proximal half transverse colon. The primary diagnosis in this case was amebic dysentery, later investigation proved to be a case of exudative colitis.

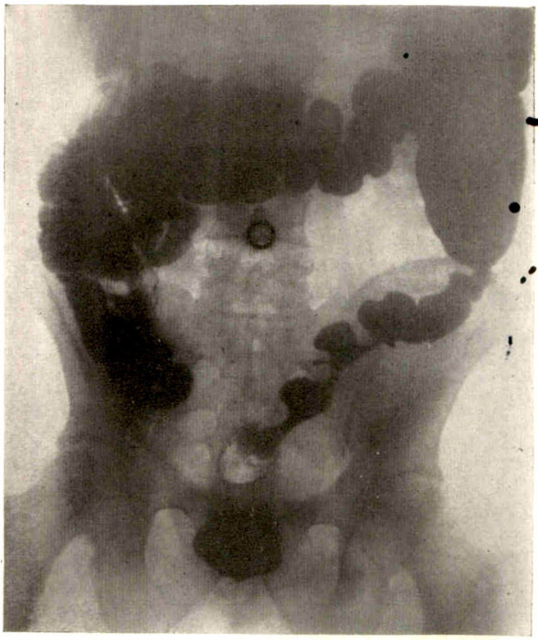

FIG. 33. Case of ulcerative exudative colitis involving the rectum, pelvic and iliac colons as expressed by the curious atypical haustration. The remainder of the colon intact showing secondary dilatation phenomena. Two distinct strictures were located by sigmoidoscopy, the one in the rectum, the other in the pelvic colon.

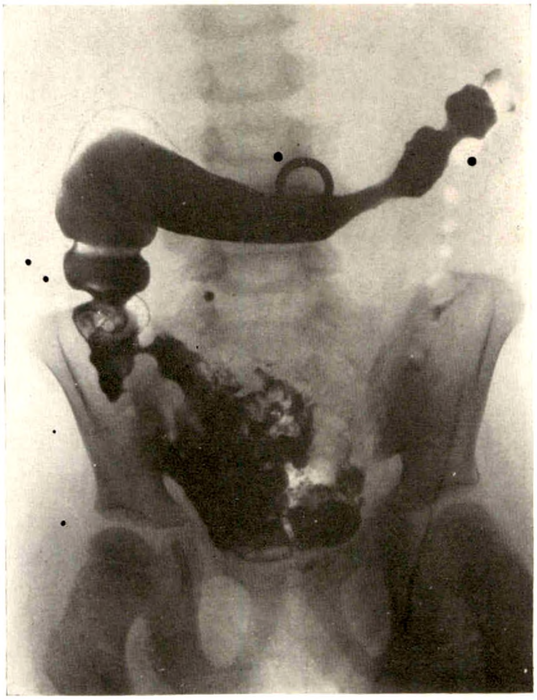

FIG. 34. Highest grade exudative colitis in child of four. Diarrhea for two years. Atypical peristalsis and haustration.

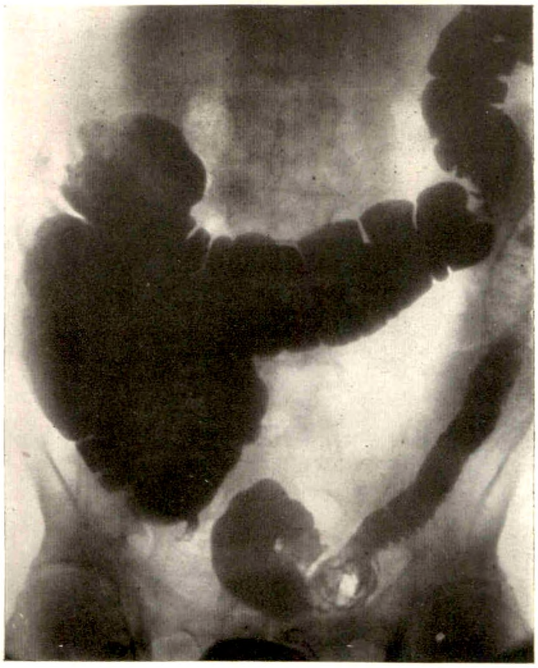

FIG. 35. Carcinoma distal transverse colon. General abdominal carcinomatosis. Proximal colon dilated, contains barium of fed test in spite of laxative. Atypical contour distal colon, striking separation reactive type. Operative confirmation.

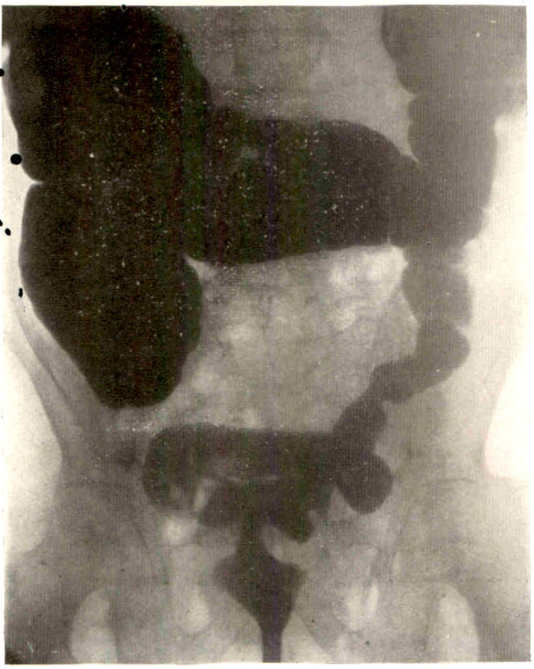

Fig. 36. Atypical pelvic colon and rectum. Striking evidence of deformity. Resection for carcinoma of rectum five years previous. Dilated cecum, ascending colon, and transverse colon.

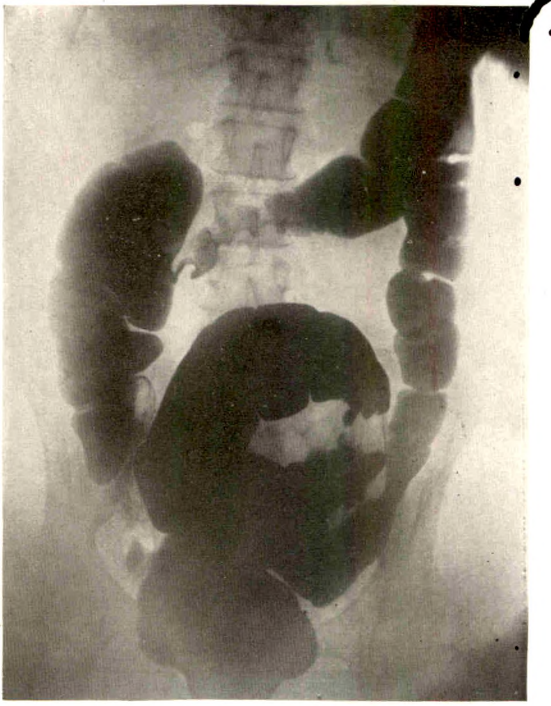

Fig. 37. Colloid carcinoma in redundant sigmoid. Apparent defect proximal transverse colon suggesting a reflex spasm (from lesion ?). Operative confirmation.

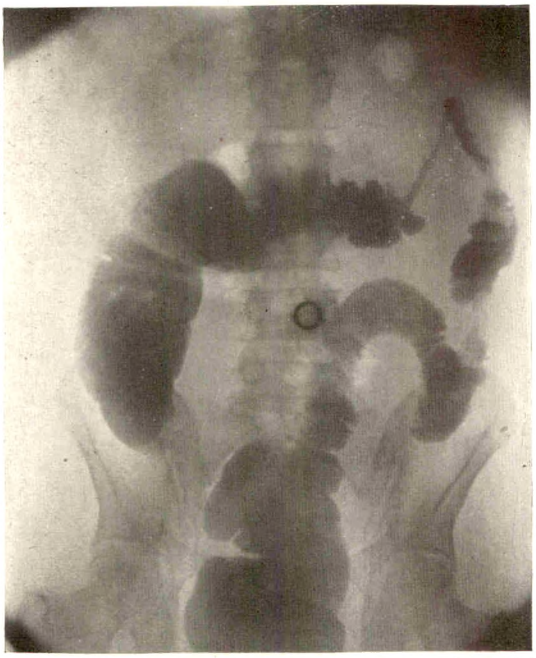

Fig. 38. Carcinoma of distal transverse colon with general secondary carcinosis with resulting "fibrillation" type of reactive haustration.

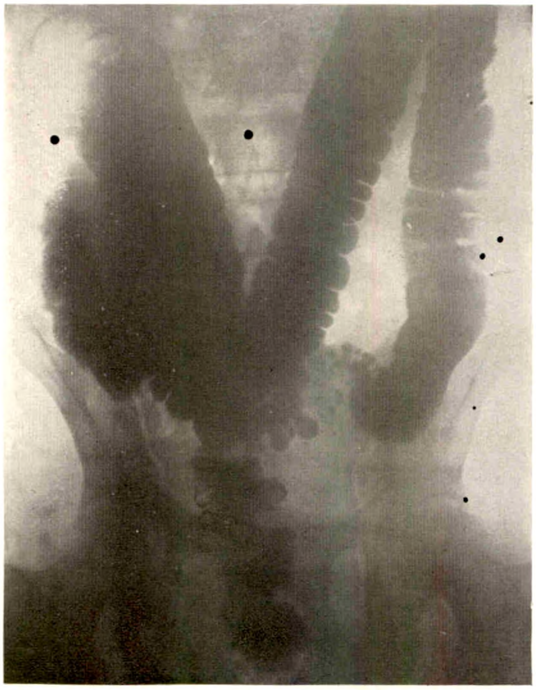

Fig. 39. Curious case sigmoidoscopically presenting evidence of general edema of the rectum. The entire lumen of the gut was almost obliterated. Profound colonic stasis resulting with acquired colonic dilatation and hypotonicity. Defensive spasticity of entire pelvic colon.

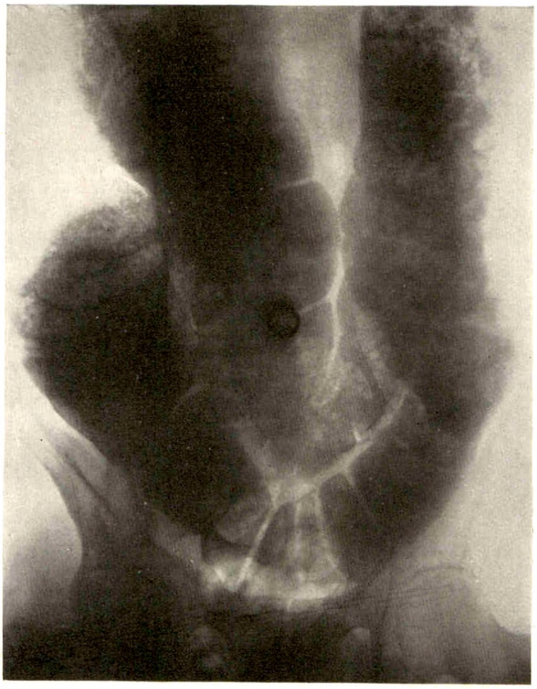

FIG. 40. Enormous dilatation of entire colon proximal to pelvirectal region, the result of obstructive lesion, carcinoma of proximal rectum. Dilatation of colon and marked colonic hypotonicity probably contributed to by morphinism.

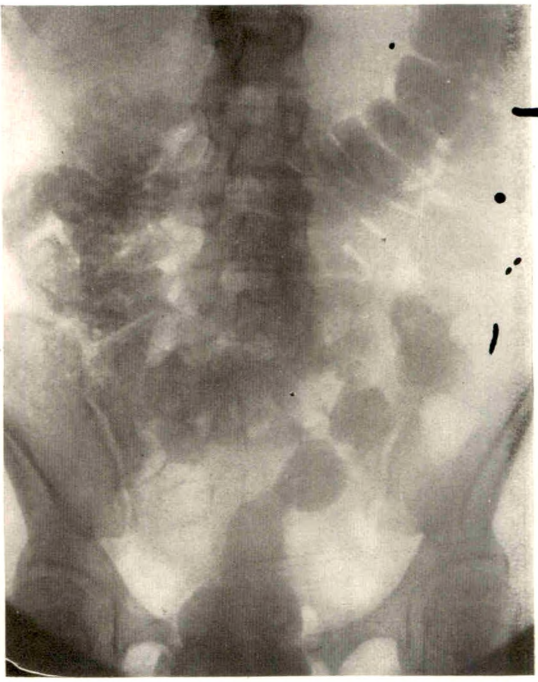

FIG. 41. Illustrating protective inhibition of colonic motility following operative trauma. Entire colon moderately filled with large collection of fecal matter and barium unquestionably residue from barium meal given seventeen days previous and now twelve days after operation (resection of iliac colon for carcinoma).

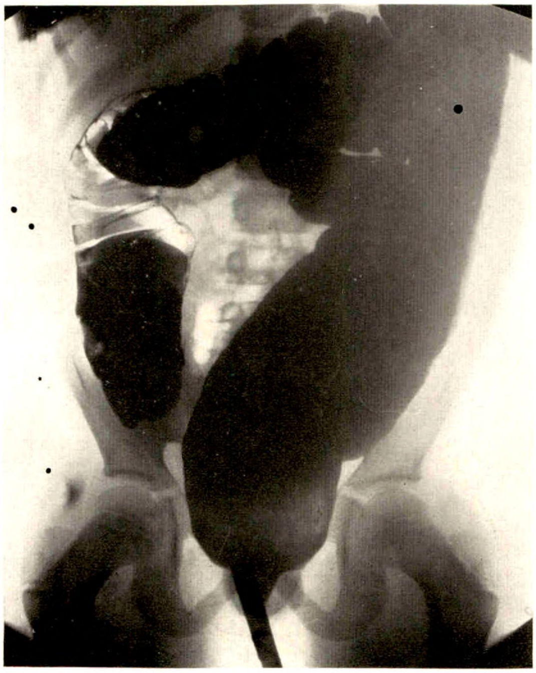

FIG. 42. Case of little boy with imperforate anus. Extraordinary demonstration of probably acquired patulence due to divulsion of the recto-sigmoid and acquired distal colonic redundancy secondary to increased distal colonic resistance in this instance congenital deformity of the rectum.

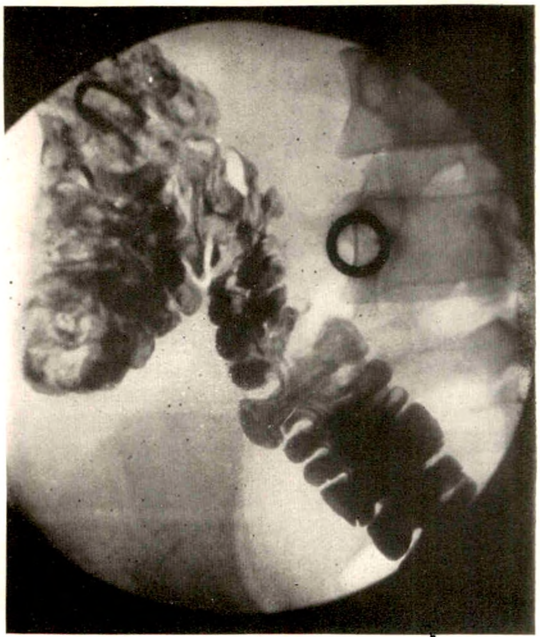

FIG. 43. Illustrating colonic rugae, lateral canalicular type. Showing peripheral colonic motility stratification and lateral compression of haustra.

by purgatives and enemas. Perhaps the most forceful argument in favor of this idea is that these abnormal tonal peculiarities lessen or disappear after considerable periods of time on treatment with restitution of normal function. It is our usual experience to be able to predict from an enema plate in a large proportion of cases whether constipation exists, its clinical type, severity and probable amenableness to treatment.

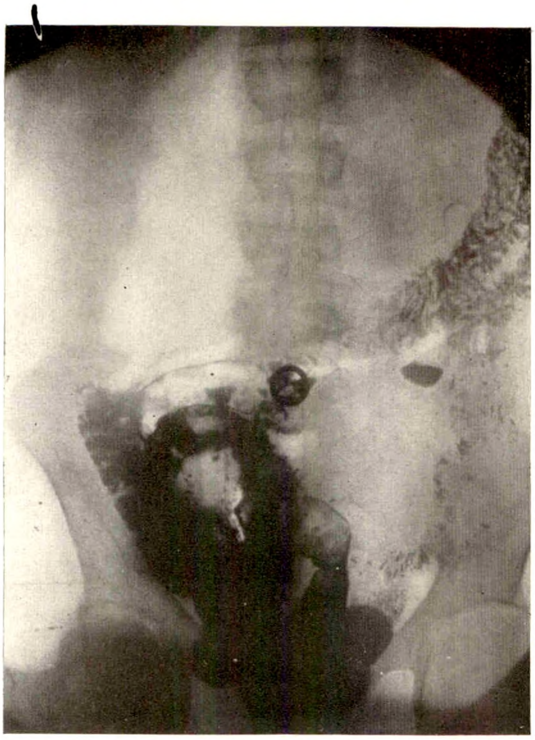

FIG. 44. Illustrating colonic rugae, a general polydirectional haustral type.

Most interestingly it is indicated that we may have light on the normal physiology of alimentary motility through its perversion in certain pathological conditions; that a carcinoma of the colon may be manifested by abnormalities in contractural and haustral outlines far distant from it, both proximally and astonishingly far distal, perhaps expressing a disturbed motor gradient, and thus visually indicating the presence of such. It is suggested that such atypical contractures represent a disturbed motor gradient—balked efforts at normal contractures and haustration. This latter it is implied has to do with motor activity as well as local retention. Perhaps we might call this perversion colonic fibrillation.

It is suggested, through resulting colonic outlines indicating slight and locally variable degrees of dilatation, that we may begin to understand how motility is interfered with in cases of organic lesions which are non-obstructive through interference with their gradients; and that there is both a proximal and distal impairment. We may through similar means gain added light on the mechanism of causation of postoperative ileus, vomiting and gastric dilatation as occurring through distant traumatic interference with gradients, to motor inhibition.

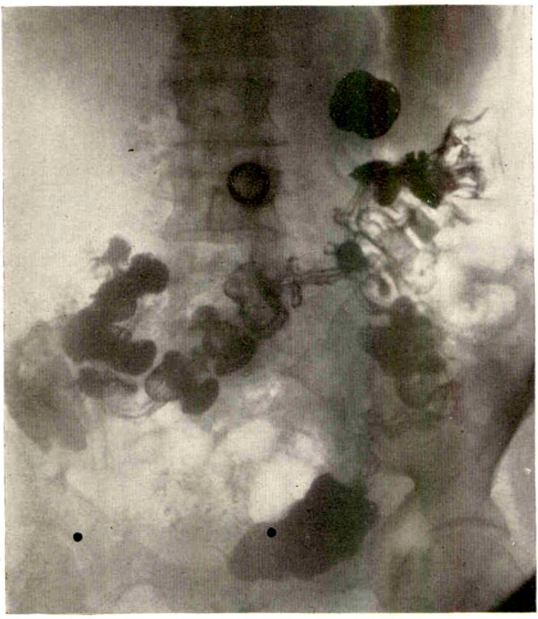

FIG. 45. Illustrating colonic rugae, haustral formation of a longitudinal compression sort.

Perhaps and most helpful of all the same agency may finally, and even now faintly, suggest factors concerned in the causation of what we call the reflex and functional dyspepsias—our ignorance of which is our greatest humiliation.

All this infers that from roentgenograms of finest quality an additional information may be obtained. I feel that this can be done and have tried to test the proposition before making such statements; though to repeat it will not as yet, if ever, be possible to submit such evidence to presently accepted standards of proof. This I may urge in extenuation, that the effort to gain light has been made in close association with clinical, laboratory and proctosigmoidoscopic findings in patients under prolonged observations.

But one point as to technique; the great importance of the barium enema as compared to the fed test as a means of studying the colon. We, as do many others, use the barium enema as a routine and find it as generally, perhaps more frequently, informative as the roentgen-ray examination of the stomach. The barium fed test has value but even as a test of colonic motility it has distinct disadvantages, and clinical tests and evidence are better.

II

THE RESTORATION OF COLONIC FUNCTION*

BY HORACE W. SOPER, M.D.

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IT is difficult to formulate a definition for the "Normal Colon." It should conform to the anatomic type or bodily habitus of the individual, be free from redundancies, spasticities, localized or general atonies and must contain a mucous membrane that is devoid of any infectious or inflammatory processes.

Loss of function in the normal colon may occur under the following conditions:

(1) Neglect or faulty defecation, usually associated with the cathartic or enema habit. As I have emphasized in former communications, 50 per cent of all the cases coming to us for constipation belong to this class. Restoration of function is accomplished by the withdrawal of all artificial aids, thereby permitting the normal mechanism to operate. Of course, general dietetic measures, abdominal muscle exercises, etc., are indicated.

(2) Function may be perverted or inhibited by a variety of factors. A chronic appendicitis, particularly the retrocecal appendix is a very common inhibitory agent; a diseased gall-bladder is apt to produce a perversion of function; hyperthyroïdism usually accelerates motility, while hypothyroid conditions delay motility; renal and cardiac disease disturb function; inflammatory hemorrhoids, anal canal fissures and ulcers are strong inhibitory factors. It is obvious that a large number of other conditions such as the infectious diseases, etc., could be cited as producing colonic motility disturbances.

(3) Infectious, inflammatory and ulcerative processes in the mucosa of the anatomically normal colon are frequent causes of motility disturbances.

It is obvious that in all of the above-named conditions involving the normal colon, a removal of the cause suffices to restore the lost function.

Before proceeding to the consideration of abnormal colonic types, I shall briefly outline what I mean by "dietetic and hygienic treatment."

(1) All purgatives and enemata must be stopped.

(2) General "laxative diet."

(3) Free use of agar-agar (heaping tablespoonful with each meal).

(4) Abdominal muscle exercises.

(5) Intermittent gradual dilatation of the anal canal.

For example: The patient in whom a normal colon has been diagnosticated, is given the above instructions. He reports in two days after having attempted defecation after breakfast. Sigmoidoscopy will determine the result of defecation, at the same time affording dilatation of the anal canal. He is reassured that nothing will happen in the event that his bowels do not act. This treatment is continued until normal function has been restored (as demonstrated by the carmine test), which usually occurs within one to four weeks.

In determining colonic function we have used the work done some years ago by Hurst as a basis. He demonstrated that about thirty-three hours is required for a meal to be entirely evacuated from the gastrointestinal tract. If taken nine hours before the act of defecation it should reach

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* Read at the Twenty-sixth Annual Meeting, American Gastro-Enterological Association, Atlantic City, N. J., April 30–May 1, 1923.

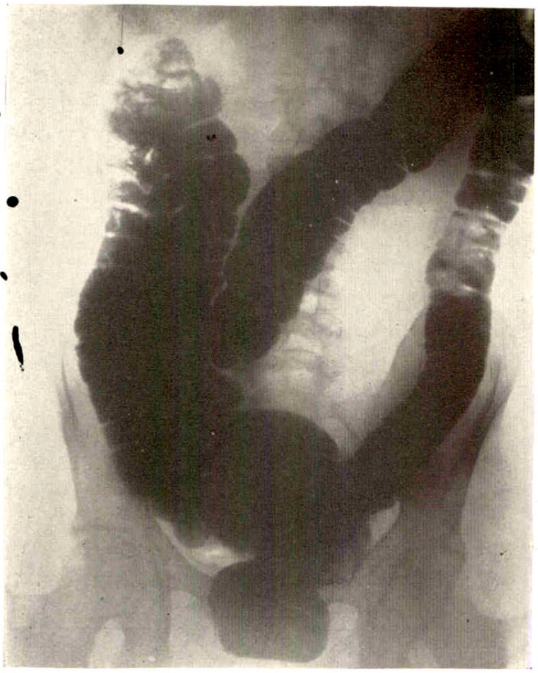

Fig. 46. Case of most extreme constipation due to retro-cecal appendix and adhesions about the cecum. Redundancy of the transverse colon was very marked. Good function was finally secured four months after the second operation.

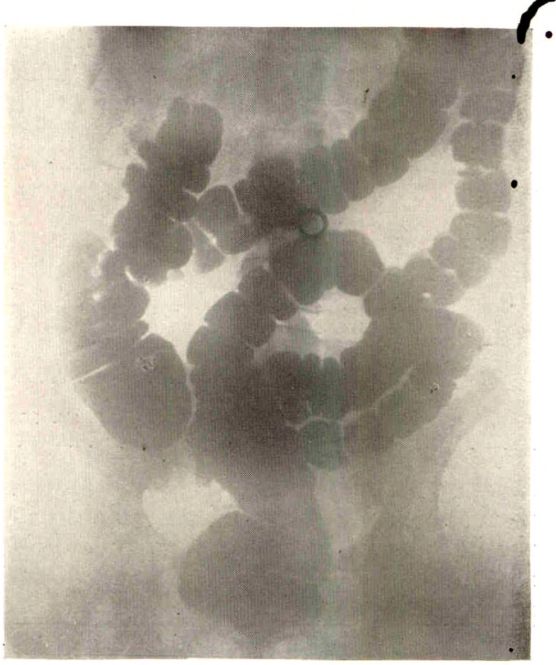

Fig. 47. Atony of the entire colon. Redundancy of the pelvic colon. Good function was secured after one month's treatment by dietetic and hygienic method with local dilatation of the sphincter muscle and treatment of the catarrhal condition of the ampulla recti.

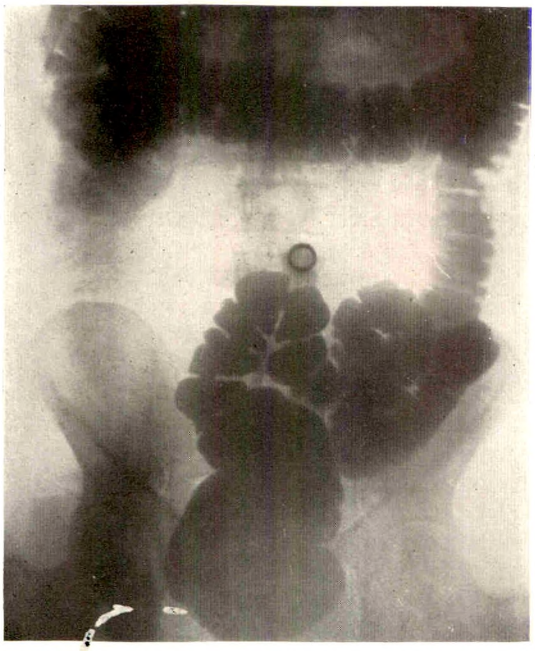

Fig. 48. Atonic rectosigmoid with redundancy and spasticity of the pelvic colon. Good function was secured by means of magnesium sulphate solution given locally.

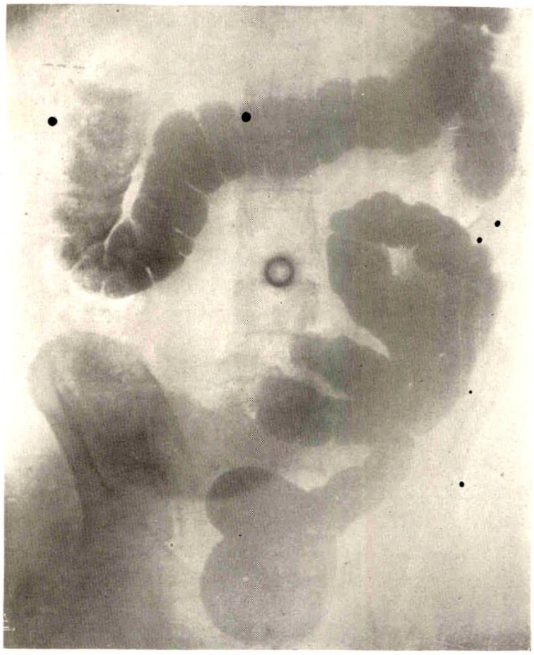

Fig. 49. Redundancy and contracture of the descending and iliac colons. Good function and disappearance of pain was secured by local treatment with magnesium sulphate.

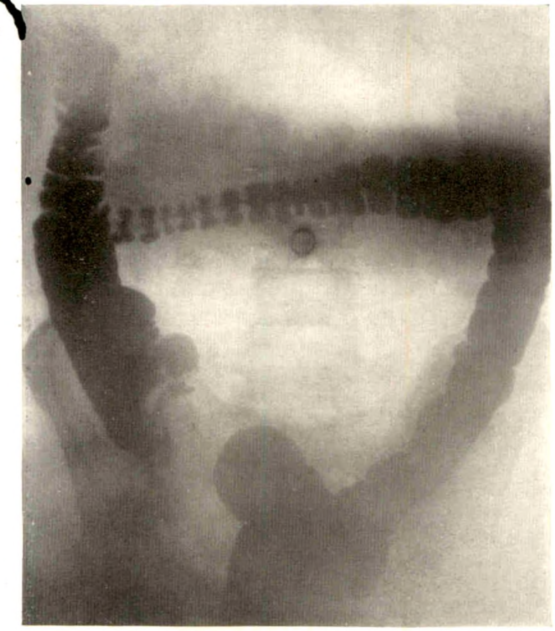

Fig. 50. Contracture of the transverse colon with atony of the rectosigmoid, iliac, and pelvic colons. Impossible to secure function by dietetic and hygienic plan. Carmine meal evacuated in seven days.

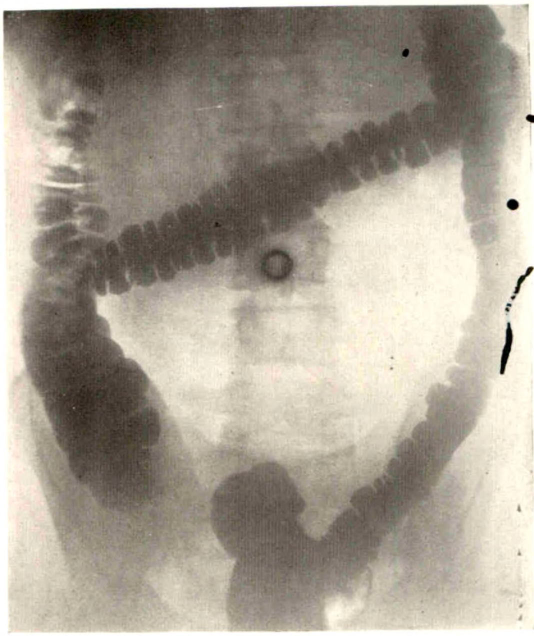

Fig. 51. Same patient as Fig. 50. Showing release of the spasm of the transverse colon by the administration of magnesium sulphate by mouth. Colon empties in normal time by the daily dose of one-half ounce of saturated solution of magnesium sulphate by mouth.

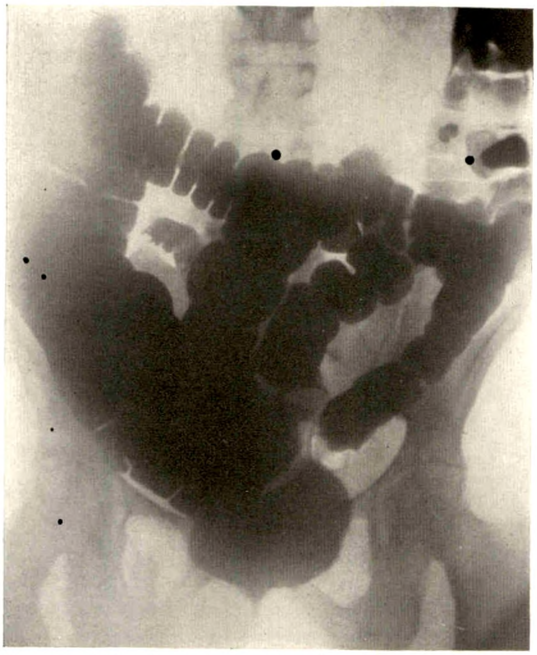

Fig. 52. Atonic redundant colon in an individual of the asthenic habitus. Dietetic and hygienic measures cause complete return of function in two months.

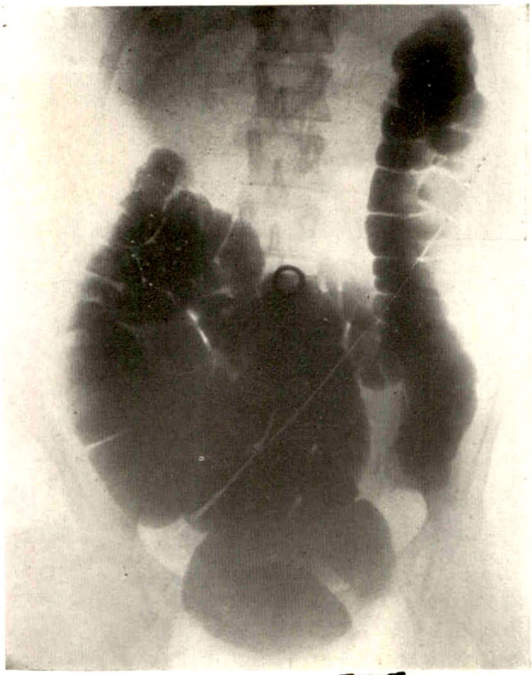

Fig. 53. Hyposthenic habitus. Marked redundancy in the pelvic and iliac colons. Transverse, pelvic and iliac colons markedly atonic. Carmine test showed retention lasting seven days. Under dietetic and hygienic regime, retention was reduced to three days with much improvement in the subjective symptoms.

the splenic flexure and part of it appear in the feces. These figures represent the time required by the average healthy individual doing active muscular work. Modification must of course be made for the asthenic type who habitually have a slower rate of colonic motility, as well as the hypersthenic type whose motility is higher than the average normal. Therefore, we have found that the following procedure establishes a very good working formula for standardizing colonic motility:

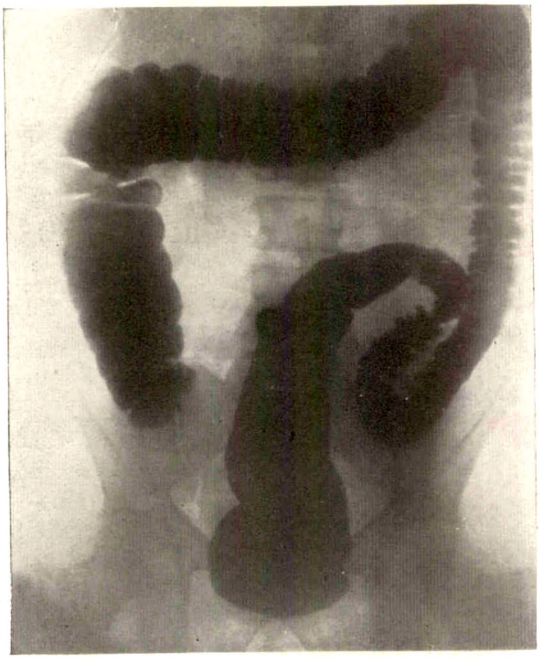

FIG. 54. This type is quite common and only occurs in persons of sthenic or hypersthenic habitus. The rectosigmoid apparatus is absent. The rectum and part of the pelvic colon markedly dilated with atonic condition of the iliac colon and portion of the pelvic colon. The resultant constipation is extremely stubborn. This patient had spasm of the sphincter muscle. He responded very well to anal canal dilatation, and the hygienic and dietetic treatment. He still has considerable motor delay. I have suggested the name, "pyramidal rectum," for this type which appears to be quite common.

The patient is given a 5-grain carmine capsule before and after his evening meal. The following morning a trace of colored matter should appear in the feces. The second morning the entire stool should be colored by the carmine. The feces evacuated on the third morning should show no trace of carmine.

VARIOUS TYPES OF ABNORMAL COLONS

THE HYPERTONIC COLON

The hypertonic or generally contracted colon is relatively rare. It practically occurs only in individuals exhibiting the hypersthenic habitus. Hypermotility is the rule in such conditions. Associated anal sphincter spasm may delay the rate of motility. Low-grade catarrhal inflammatory conditions are frequently present in the mucosa of the anal canal and rectosigmoid region. Diverticulosis is frequently present. Patients of this type should abstain from raw foods and should avoid all laxatives and purgatives. Local treatment consisting of sphincter dilatation and dry powder insufflation is indicated.

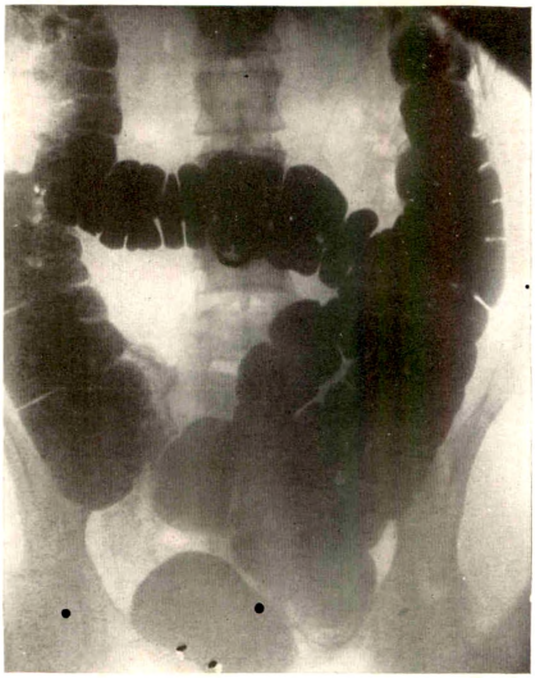

FIG. 55. Redundancy of the iliac colon in patient of the sthenic habitus. Habitual cathartic taker. Responded very well to dietetic and hygienic treatment.

THE ATONIC COLON

Cases of general atony are more frequent than general contracture. It occurs in persons of the asthenic habitus in a large majority of cases. Colonic motility is very slow, the carmine test often showing retention from seven to eight days. In the aver-

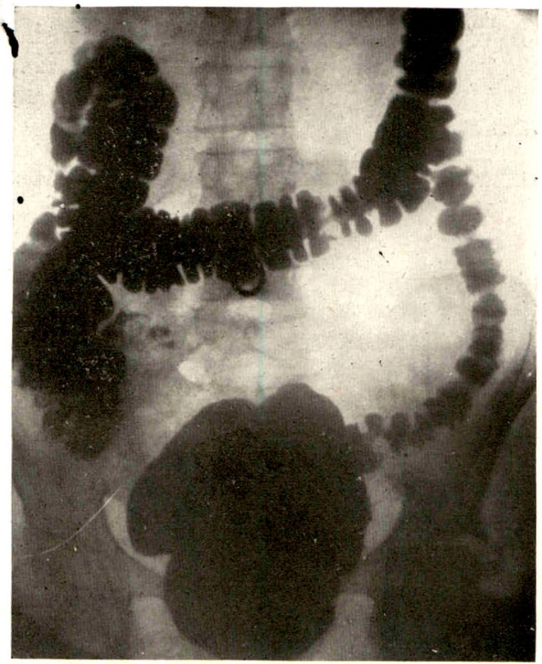

Fig. 56. Case of extreme atony of the rectum and pelvic colon with contracture of the descending and iliac colons. All attempts to secure function in this case failed. She is a confirmed invalid and can only get help by means of a large enema once daily.

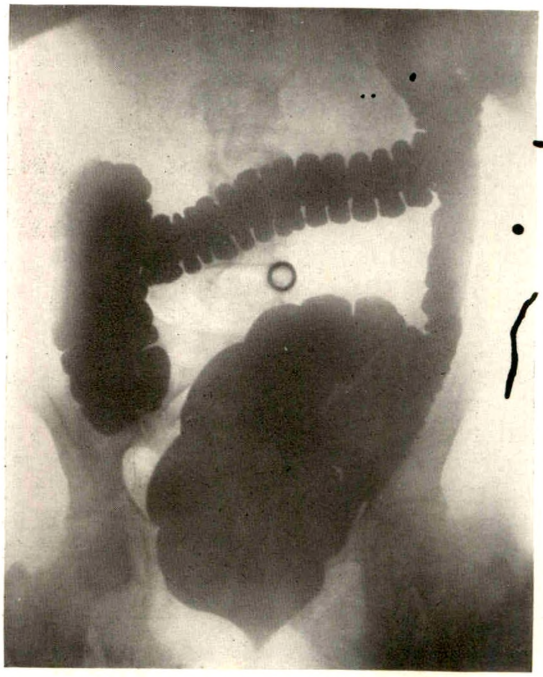

Fig. 57. Case of same type. Patient also confirmed invalid. Large enema is the only means of getting temporary relief.

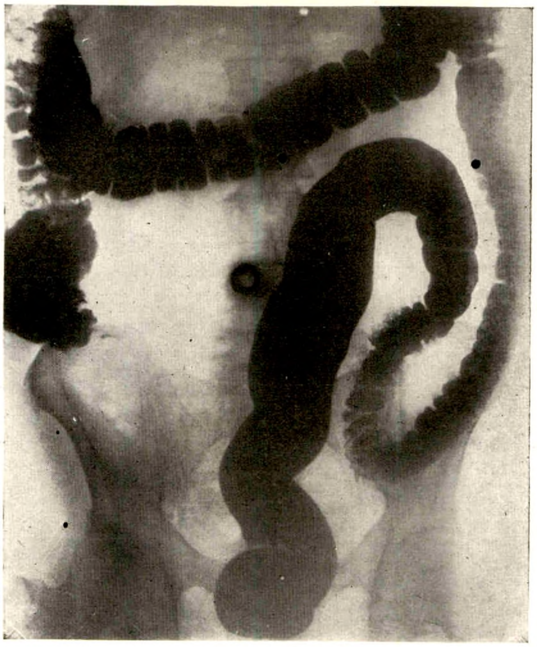

Fig. 58. Another type of pyramidal rectosigmoid with contracture of the iliac and portion of the pelvic colon with diverticulosis. Case anomalous inasmuch as patient complained of alternating diarrhea and constipation. The diverticulitis caused severe pain, probably responsible for the developing of the diarrhea.

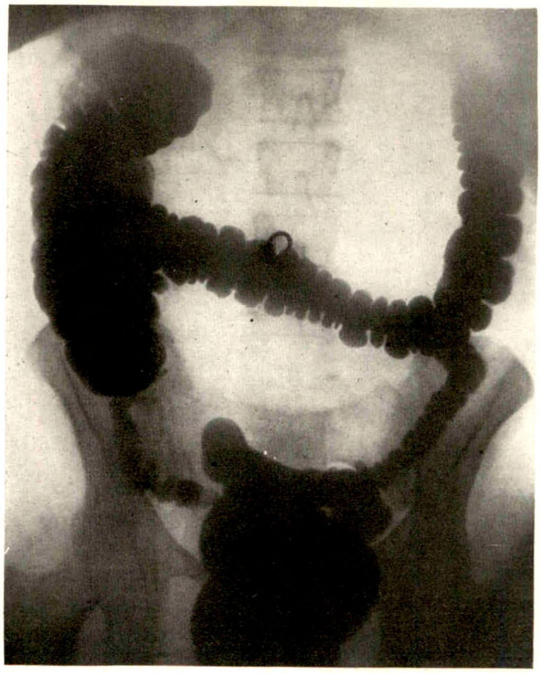

Fig. 59. Atony of the pelvic colon and rectum with strong contracture of the descending and iliac colons. Absent rectosigmoid apparatus. Severely constipated. Enema user. Restoration not possible.

age case, restoration of function can be accomplished by the use of the *dietetic and hygienic regime* as above outlined. In addition to this we use local applications of double salt (magnesium sulphate and sodium sulphate, 25 per cent of each), in the beginning of the treatment. The important point is to delay defecation until formed fecal matter can reach the rectum. At first the daily evacuation will be small, but gradually the colonic muscle fibers increase in tone and the evacuation will be larger in volume. In severe cases of this type restoration of function is impossible and resort must be made to purgatives and enemata. Many of my patients do very well on pure fluid extract of cascara sagrada in drop doses before each meal. The intelligent patient controls the dosage to such a nicety that daily formed evacuations are secured without the appearance of mucus in the feces.

ATONIC CONDITIONS OF THE COLON ASSOCIATED WITH SPASM OF THE ILIAC COLON AND RECTOSIGMOID

Treatment consists in local applications of magnesium sulphate solution through the sigmoidoscopic tube as described in former papers. After this has been accomplished treatment is the same as that for *simple atony* as above outlined.

THE REDUNDANT COLON

Colonic redundancy occurs more frequently in persons of the asthenic habitus and is associated with atonic conditions. In some cases of quite extensive redundancy, colonic motility is normal. In other cases a very obstinate type of constipation results. Motility appears to depend largely on the quality of tonus existing in the colon. Restoration of function should always be attempted. Redundancies occurring in the descending colon are particularly apt to be associated with a considerable amount of pain. Redundancies in the iliac and pelvic colon are usually accompanied by symptoms of bloating and distention in the lower abdomen with a great complaint of "gas" on the part of the patient. Redundancies often appear to be the cause of many cases of dyspepsia, using the term in its broader sense, i.e., disturbed gastric motility, functional in character.

CONTRACTED DESCENDING AND ILIAC COLON WITH ATONY OF THE PELVIC COLON AND RECTUM

This type produces constipation of obstinate character. It is obviously impossible to attempt restoration of function in this type. Water irrigation is really the only means of relief. The cases I have seen have all been chronic invalids. Surgical relief does not seem possible.

CONTRACTED ILIAC AND PELVIC COLONS WITH EXTREME ATONY OF THE RECTUM AND DISTAL PORTION OF THE PELVIC COLON

(Absent rectosigmoid apparatus)

This condition is more frequently found in sthenics and hypersthenics. I have designated it the "pyramidal rectum." Diverticulosis is usually present in the lower iliac or upper pelvic colon. Obstinate constipation is the rule but many patients appear to get fairly good function under hygienic and dietetic treatment.

SUMMARY

Restoration of function may be secured in practically all normal colons by the dietetic and hygienic method. It is important that concomitant low-grade inflammatory conditions receive appropriate treatment, also that sphincter spasm be overcome by gradual dilatation of the anal canal.

The best stimulants to colonic contracture may be named in the following order:

(1) The presence of formed fecal matter in the rectosigmoid region.

(2) Gradual intermittent dilatation of the anal canal.

(3) The presence of food in the stomach.

(4) The act of defecation.

(5) The use of well-considered daily abdominal muscle exercises.

MASSIVE COLLAPSE OF THE LUNG*

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EARLY in 1922, a case of massive collapse of the lung was studied in the Roentgen-ray Department of the Massachusetts General Hospital, and reported with a review of the literature by Dr. Max Ritvo.[1] Since then, we have had an opportunity to study 4 more cases which form the basis of this paper.

Massive collapse of the lung is of fairly frequent occurrence in surgical clinics. Of 201 cases of lung complications out of 3,559 patients operated upon in the Middlesex Hospital between the years 1906 and 1910, Bradshaw found 12 cases of massive collapse with 1 death.

During a period of two years, Elliot and Dingley[2] observed 11 cases, all of which followed abdominal operations.

In discussing the etiology of postoperative pulmonary complications, Cutler and Hunt[3] state that a survey of all types of such complications that occur reveals the fact that there are certain anatomic fields in which these sequelae follow operation most commonly. They are largely restricted to two great areas; one, the abdomen, and the other, the mouth, face and neck. In abdominal operations, the incidence with local anesthesia is quite as high as when inhalation anesthesia is used. In operations on the mouth, face and neck, however, the use of local anesthesia has undoubtedly cut down both the morbidity and mortality percentages. They do not mention massive collapse as a postoperative complication, but I think it quite possible that in some of the abdominal cases which he studied the symptoms were due to massive collapse.

John Rose Bradford[4] defines massive collapse of the lung as "an unusual condition in which the lung, without the presence of any gross lesion such as bronchial obstruction, pleural effusion, etc., interfering with the free entry of air, becomes airless to a greater or less degree, and, therefore, useless for respiratory purposes."

It usually involves an entire lobe, and not infrequently the whole of one lung. Symptoms may be present or absent. They may be of extreme urgency or of only moderate severity. When the symptoms are absent, as is by no means rare, and as it is always a complication of other diseases, or of injury, massive collapse is overlooked frequently. In practice, it is most often seen following abdominal operations, especially those for hernia and appendicitis. Its cause is not entirely understood, but it is frequently accompanied by a partial or complete paralysis of the diaphragm on the affected side. Any injury or infection which causes paralysis or fixation of the diaphragm, either directly or indirectly, may be accompanied by collapse.

Physical Signs and Symptoms. The condition may develop within a few hours or as late as one week after the exciting trauma. The onset is sudden; the course either rapid or at times protracted; and resolution either prompt or slow. The degree of temperature is usually very moderate, but may be as high as 103° or 104° F., the coincidence of pneumonia probably influencing the height of the temperature curve. The respiration-rate is increased by the immobility of the affected part, by an accompanying pleuritis, or by toxic conditions incident to inflammatory complications. The pulse-rate is found to be more or less in direct relationship with the respiratory and thermic changes, but is less marked in uncomplicated cases.

The examination of the chest shows diminished or absent excursion of the chest wall over the affected area. The cardiac impulse is displaced toward the affected side. In left-sided cases, the apex has a tendency to tilt outward and upward, so that the apex-beat may be felt in the axilla. In right-sided affections, the impulse may be felt at the tip of the sternum or to the right of it. In bilateral affections, the displacement of the heart is absent, but the high position of the diaphragm is manifest. On palpation, the intercostal spaces on the affected side are found to be narrowed. The percussion note over the affected area is dull and may approach flatness. Breath sounds and fremitus are usually increased, sometimes enormously so, but may be diminished or absent. The transmission of voice sounds may be intense. Râles are usually absent in the early stages, but appear as the case progresses, probably due to bronchitis or pneumonia developing. In many cases, a pleural friction rub is plainly audible. In the later stages of the condition, when expectoration may be profuse, it is rarely, if ever bloody—an important point in the differentiation from pneumonia and infarction. As resolution occurs, the heart gradually returns to its original position, the lungs slowly expand and the diaphragmatic dome flattens.

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* Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J. Jan. 24–2[illegible], 1924.

Differential Diagnosis. Cases of massive collapse have to be differentiated from other pulmonary complications, the most common of which is inhalation pneumonia or abscess, and from infarction and the lighting up of a previous pulmonary infection. It is well to remember that massive collapse usually follows operations on the abdomen or thorax, and has never been reported as following operations on the mouth, head or neck. The inhalation pneumonias are rather more frequent following head operations. The symptoms are less severe than with pneumonia or infection, and the sputum is never bloody. The displacement of the heart and mediastinum to the affected side is the most striking finding. The extent of displacement in massive collapse is usually great. In acute abscesses and pneumonias, the displacement, if any, is slight.

Roentgen Findings. Scrimger[5] examined 6 cases, 5 of which were fairly complete roentgen studies. He gives displacement of the heart to the affected side as the most characteristic finding. This is usually accompanied by a high, rigid diaphragm with dullness in the affected portion of the lung.

Our observations seem to bear out his conclusions. In all of the cases in this series, there was marked displacement of the heart with the mediastinal contents, to the affected side; the diaphragm was high; and the roentgenoscopic observations showed no respiratory excursion. The shadow of the lung in the affected area was more dense than normal, and of a gray, mottled character, the density increasing toward the base. When the lower lobe was involved, the outline of the diaphragm was indistinct or absent. As the process clears up, the density diminishes, and the mottling in the affected area becomes more distinct, so that in some stages it may resemble closely the mottling of tuberculosis. As the lung expands, the heart returns to normal position, but the diaphragm is apt to remain somewhat elevated and limited in respiratory excursion. Not infrequently, pneumonia develops in the affected lobe, and will be shown on the plate as a sharply circumscribed area of increased density. At this time, the heart may have assumed the normal position.

The roentgen findings in massive collapse simulate very closely those seen in collapse of the lung from other causes, such as foreign body in the bronchi, syphilis and primary malignant disease; and from the plates alone it may be impossible to make a definite diagnosis. The history should make the diagnosis clear in most cases, but if there is still doubt repeated plates should be taken.

Extreme displacement of the heart, the most characteristic finding, is sometimes seen in diseases of the lungs of infectious origin, especially those chronic lesions accompanied by extensive fibroid changes. But in these conditions, the shadow cast by the affected lung is more irregular, and may even show evidence of cavity formation. The correct interpretation can usually be made from these findings.

CASE REPORTS

Case 1. Miss V. S., a stenographer, aged twenty; gave no history of past or present respiratory infection, and a preoperative roentgen examination of her chest was negative. A left oöphorectomy and right salpingo-oöphorectomy with routine appendectomy was performed for bilateral multilocular adenocystomata. The operation was a difficult one and attended with some shock, but was completed in one hour. Ether anesthesia with gas induction was employed. During the operation the respirations were rapid, shallow and irregular, with excessive mucus. On the evening of the following day, there was a sudden rise of temperature, pulse and respiration accompanied by dyspnea; and examination showed limited excursion of the right chest with flatness to percussion and diminished breath sounds below the clavicle. The heart was displaced to the right. The next day her condition was better, and she was raising a small amount of purulent sputum showing diplococci and streptococci. Sonorous râles were present throughout both lungs, and below the angle of the scapula on the right there was bronchial breathing, egophony, increased voice sounds and normal tactile fremitus. The leucocyte count was 14,000. The temperature rapidly came to normal, the sputum ceased and she was discharged on the ninth day (Figs. 1 and 2).

Summary of Case. This patient had a rather extensive abdominal operation which was followed in two days by the onset of acute pulmonary symptoms that cleared up rapidly, and in which the clinical picture was not that of postoperative pneumonia. The observations are incomplete in that no plates were obtained after complete expansion of the lung. The patient was discharged on the ninth day after operation. This patient has since died, probably from extension of the malignant growth in the abdomen. The most characteristic appearance seen in the plates is the marked displacement of the heart and mediastinum, the high diaphragm and the general haziness in the lung field. I am unable to explain the presence of the shadow suggesting air between the collapsed lung and the diaphragm, as the patient was not tapped, and there is no reason to suppose that the diaphragm was injured during operation.

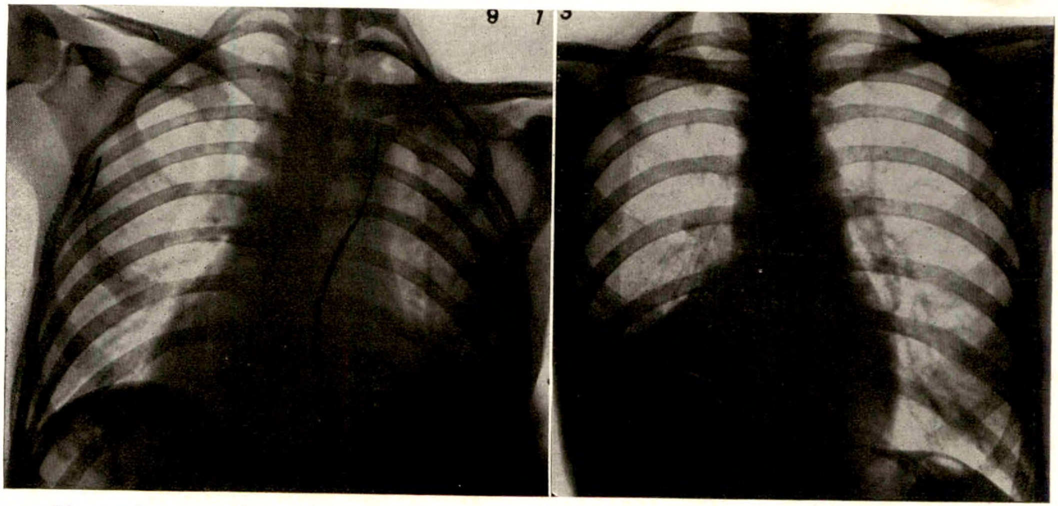

Fig. 1. Plate taken two days after operation. The examination was made with the patient prone and plate behind. It shows decreased radiance throughout the right chest, narrowing of the intercostal spaces on this side, rather coarse mottling in the lung field in the lower half of the chest, displacement of the cardiac and mediastinal shadows, including the trachea, to the right, and high position and hazy outline of the diaphragm.

Fig. 2. Taken seven days later, at which time the patient was practically symptom-free. This plate was made in the upright position, with the plate in front. The heart is still displaced to the right, the diaphragm high on the right side and sharply defined, and there is a triangular area of dullness above it. This area of dullness extends from the hilus of the lung outward and downward across the chest nearly to the axillary border. It has sharply defined borders and suggests a collapsed lobe. The remainder of the lung fields are of normal brilliancy.

Case ii. T. C., a schoolboy, aged fourteen; gave a history of frequent head cold and asthmatic attacks during each winter, and hay fever in the summer. He had a cough two weeks before admission. A small, indirect, left inguinal hernia was repaired under novocain infiltration, the operation being completed in forty minutes. During the next two days, his temperature was slightly elevated, and he had some abdominal discomfort. On the third day, his respirations rose to 40 with apparent air hunger and a frequent unproductive cough. He complained of dull pain in the right chest on deep inspiration. On examination, the right chest was immobile, and the interspaces narrowed. Anteriorly there was dull tympany with absent breath and voice sounds. Posteriorly at the base, the chest was flat, with absent breath sounds, voice sounds and tactile fremitus. In the region of the hilus, there was an area of hyper-resonance with increased voice sounds and loud bronchial breathing. There were no râles. The heart was slightly displaced to the right. The temperature was higher the following day with a leucocytosis, the leucocyte countbeing 25,400, and there was a small amount of purulent sputum containing Type IV pneumococci. Subsequently the temperature returned to normal (Figs. 3, 4 and 5).

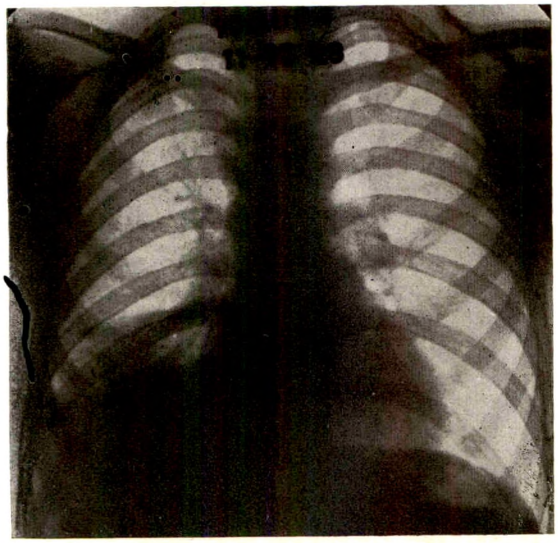

FIG. 3. Plate taken three days after operation, with the patient supine and plate behind. It shows markedly diminished radiance throughout the right half of the chest, the intercostal spaces are narrowed, and the heart and mediastinum, including the trachea, are displaced to the right. The lung has a hazy, mottled appearance. The diaphragm is high and its outline indistinct. The left lung appears normal.

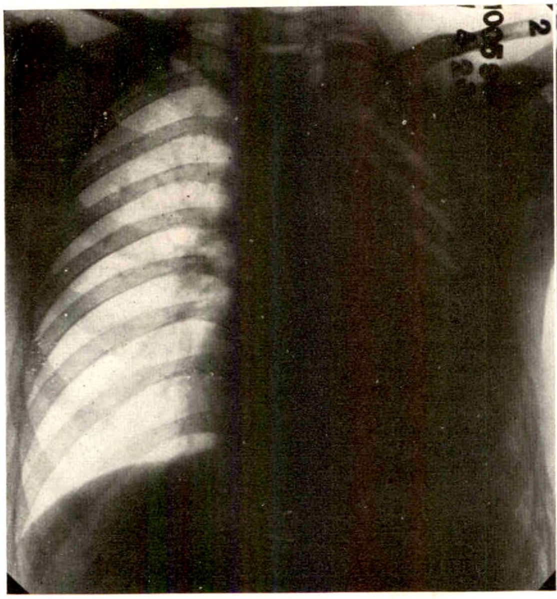

FIG. 4. Taken three days later in the same position. It shows a decrease in density on the left side, and a beginning return of the heart and mediastinum toward the mid-line.

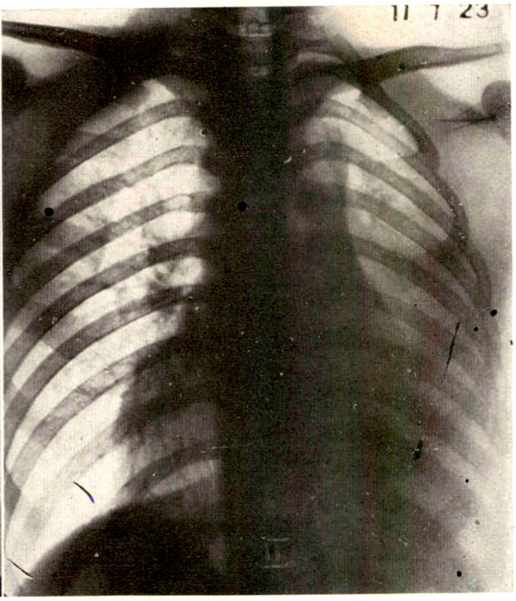

FIG. 5. Eight days after the first plate. It shows a practically complete clearing of the outer half of the right lung field, and return of the heart and mediastinal contents to practically normal position. But the lower half of the right chest is more dense than in any previous plates. The dullness has a slightly curved border, higher in the median than in the axillary line. Its margins are sharply defined, and the outline of the diaphragm is obscured. The appearance now suggests lobar pneumonia.

Eleven days after the onset of symptoms, another examination was made with the patient upright and the plate in front. It showed a clearing up of the localized area of density in the right chest. Through it the outline of the diaphragm was visible, but there was no respiratory movement present on this side.

Another examination was made fifteen days after the first observation. It showed a normal lung on both sides, except for a small area in the cardiohepatic angle on the right side. The diaphragm on the right was still high and there was limitation of respiratory excursion.

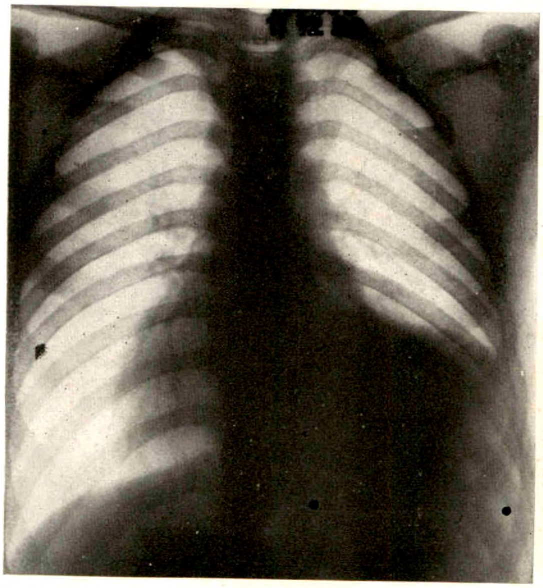

Fig. 6. Shows an increased density throughout the right half of the chest. The density is most marked toward the base where it obscures the outline of the diaphragm which is apparently high. The intercostal spaces are narrow, the mediastinum, including the trachea, is displaced to the right. The lung field has a hazy, mottled appearance. On the left side, the lung is of normal radiance throughout.

The last observation was made on December 29, 1923, nearly two months after the first examination. It showed no definite variation from the normal in the chest other than moderate increase in the hilus shadows. The position, outline and respiratory excursion of the diaphragm had returned to normal.

Summary of Case. In this case, the clinical and roentgen findings point to a massive collapse of the right lung following operation for hernia under local anesthesia. This collapse was probably followed by pneumonia at the right base. As no general anesthesia was given, it is quite improbable that the findings were due to inhalation pneumonia, and there is nothing in the picture to suggest infarction. It is unfortunate that we had no plate of the chest before the operation. This would seem to be a true case of massive collapse complicated by pneumonia.

Case III. G. G., a healthy young man, aged nineteen; was operated upon for subacute appendicitis, the symptoms being of ten days' duration. A slight non-productive cough present before operation was attributed to pharyngitis from smoking, and there were no other signs or symptoms of respiratory infection. The operation was completed in forty-five minutes, the appendix being removed in routine manner. Ether anesthesia was uneventful except for noisy respirations and some mucus. He coughed considerably during recovery from the anesthetic, and the following day; but otherwise his convalescence was normal until the second day when he had a chill, with the onset of a cough, marked dyspnea

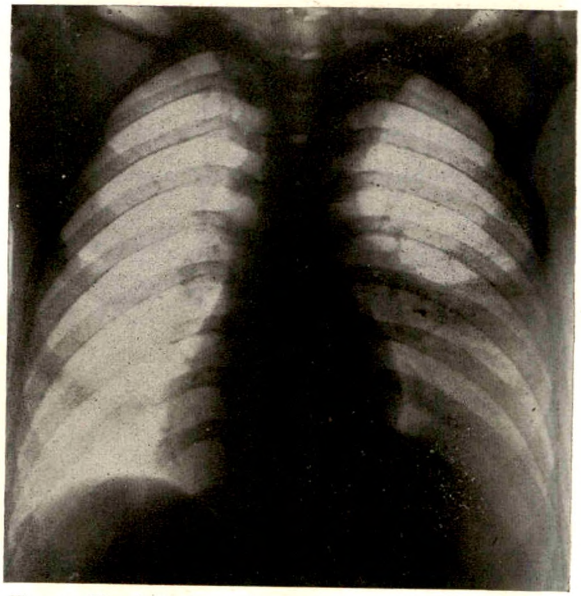

Fig. 7. Six days later. It shows considerable dullness in the lower half of the right chest. The dullness is of a mottled character. The diaphragm is still high, and the heart is still displaced toward the right.

and cyanosis. The respirations mounted to 48 and the temperature to 103°F. Physical examination showed limitation of excursion of the right chest with eversion of the costal border. The right chest was dull throughout with diminished breath sounds, and in the region of the scapula was a patch of loud bronchial breathing, egophony, increased voice sounds, and tactile fremitus. No râles were present. The heart was displaced to the right. A moderate amount of purulent sputum showed pneumococci of Type III. The respiratory embarrassment soon disappeared, the sputum became less, and on the sixth postoperative day the temperature became normal and remained so (Figs. 6, 7 and 8).

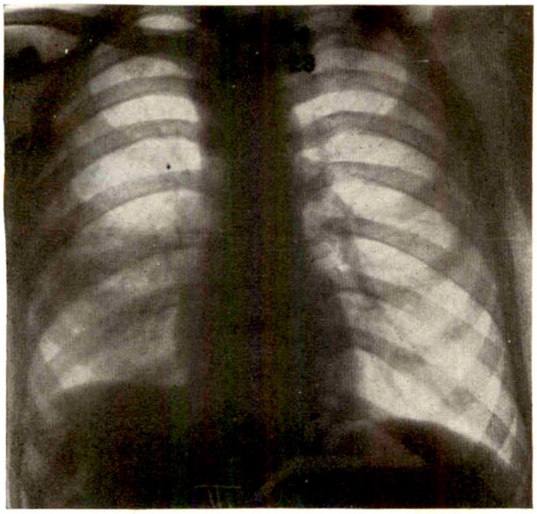

FIG. 8. This plate shows some mottling in the lower half of the right chest, but less than on the previous examination. The diaphragm is nearly back to normal position and sharply outlined. The heart is still slightly to the right.

Summary of Case. The plate taken three days after operation shows the picture quite characteristic of massive collapse. The lung was rather slow in clearing up, and the changes had not entirely disappeared at the time of the patient's discharge, although he was practically symptom-free. This case is probably one of [redacted] collapse.

CASE IV. D. S., a chauffeur, aged forty; postponed his admission ten days because of an acute upper respiratory infection. A repair of bilateral inguinal hernia was then done under epidural anesthesia, the operation being completed in an hour and a half. Cough and purulent sputum began almost at once after the operation, and the following day the temperature rose to 102°F., with a leucocyte count of 20,000. There was no pain, chill or noticeable respiratory embarrassment. Examination showed dullness throughout the right chest, most marked at the base, with diminished breath sounds and tactile fremitus. Below the angle of the scapula, there was a small area of bronchial breathing, with coarse râles. Cough with purulent sputum containing pneumococci persisted several days, otherwise his condition rapidly improved, and he was discharged on the sixteenth day (Fig. 9).

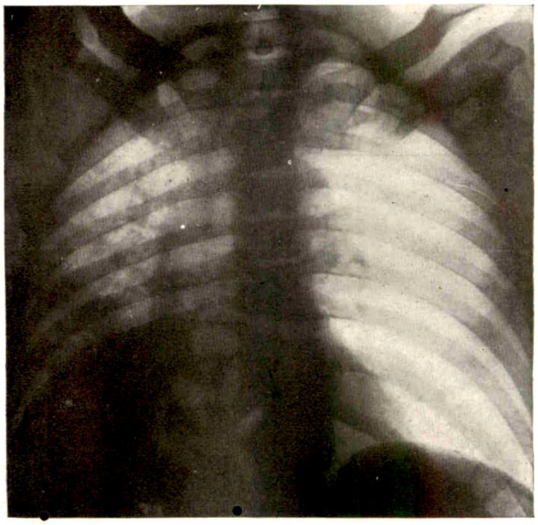

FIG. 9. The entire right chest is less radiant than normal. The density increases toward the base where it obscures the outline of the diaphragm which is high. The lung presents a hazy, mottled appearance. The heart and mediastinum, including the trachea, are displaced to the right. The left lung appears normal.

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DISCUSSION

Dr. Holmes. I feel that I ought to make an apology for the title of this paper. There are a few good clinicians who doubt that there is such a thing, and I am not entirely convinced myself. The way in which I put it would make one think I am fairly well satisfied that we have such a condition. I do think, however, that there is a condition occurring following operation which we, as roentgenologists, have not been recognizing and which I thought perhaps was worthy of bringing before a body of this kind.

Dr. F. H. Baetjer, Baltimore, Md. After all abdominal operations do you not find the diaphragm mobilized?

Dr. Holmes. Yes, and that may be the cause of the massive collapse.

Dr. Baetjer. How soon do you see these cases after the onset of the symptoms?

Dr. Holmes. The onset of the symptoms usually occurs about the second or third day, and we usually see them the same day or the day following.

A Member. Could you see the movement of the diaphragm in all stages?

Dr. Holmes. Not in all stages, but in some stages of every case.

Dr. Baetjer. When you say massive collapse of the lung, do you mean it as if you should take a sponge and squeeze it together? Do you mean atelectasis?

Dr. Holmes. Yes, the air is out of the lung and it more or less collapses. Of course it does not necessarily mean that the whole lung is collapsed on one side, it may be just a lobe, and I think these cases I have shown have all been the lower lobe.

Dr. Baetjer. There is no pleurisy associated with it?

Dr. Holmes. No, not necessarily. The most conclusive paper I did not quote at all, and that is Pasteur's work on massive collapse following diphtheritic paralysis. He studied a large number of cases where there was paralysis of the diaphragm following paralysis of the phrenic nerve in diphtheria, and he had 8 or 10 cases that came to autopsy. He was able to demonstrate that the lung was collapsed on the side on which the diaphragm was paralyzed, without evidence of disease process in the lung. Then of course during the war the wounds of the chest wall, even though there was no penetration of the chest, did produce definite collapse of the lung. It is not necessary to have anything in the pleural space to take the place of the collapsed lung, because the diaphragm comes up and the mediastinum goes over to take the place of the lung. In war work it was of a good deal of importance, because if you opened the other side of the chest the patient would die.

Dr. Isaac Gerber, Providence, R. I. May I ask Dr. Holmes if he recalls a case in a child demonstrated in Boston one night? Dr. Sossmann proved it to be a case of tumor in one of the bronchi. It was eventually removed by Dr. Crosby Green through a bronchoscope, and the physical and roentgen signs were essentially those of massive collapse of the lung. I believe it had the same basal shadow, high diaphragm and displacement of the heart reported in your cases, and it cleared up after removal of the tumor, which was in the wall of the bronchus. I believe that proves the mechanics of what you claim as the massive collapse of the lung.

Dr. Holmes. I remember that case very well as I had an opportunity to see it. We know that we can produce a massive collapse by plugging the bronchus, either with a foreign body or by syphilitic ulcerations of the bronchus or by any form of new growth. I do not recall the man who did the experiment, but experimental work on animals has been done, tying the bronchus and plugging it up, producing the collapse. The alveolar air is rapidly absorbed if you plug the bronchus but in this form of collapse I present it is possibly not produced by the plugging of the bronchus. That is one of the big arguments those who are working on this subject are having at the present time, whether there is a plugging of the bronchus or a collapse from some other cause, and in the opinion of those who ought to know, there is no plugging of the bronchus in these cases.

A Member. I would like to ask Dr. Holmes if all the cases of this series had rise of temperature, and if so, why?

Dr. Holmes. All of the cases that I reported did have a rise in temperature, and as one of our best internists thinks, these cases were all pneumonia, and I took the precaution to mention that when I started. I do not think, however, that you can account for the extreme displacement of the heart by any inflammatory process. I also think that there are cases in which there is no rise in temperature, although we have not been able to get them. Something must happen to call the clinician's attention to the fact that something is wrong with a patient before we get a chance to examine him. We are planning to have roentgenograms taken immediately after operation, so we may be able to pick up those things before they show clinically. We think in a certain number of cases a collapse occurs which is over perhaps in an hour or two.

Dr. W. F. Manges, Philadelphia. Have you considered the possibility that this is an inflammatory process that involves primarily the terminal branches of the bronchi, the lumina of which are exceedingly narrow and may readily become occluded so that the air may become absorbed and a diminution in the size of the lung and a rise in temperature occur? In pneumonia it does not occur because exudate fills the air vesicles, but I can conceive of cases involving the terminal bronchi in which the lumina might be filled without at the same time filling the bronchi. I think a certain degree of proof of that might be in the fact that exudates from various kinds of inflammatory processes in the lungs vary greatly, sometimes being exceedingly thick so that they cannot come out through the glottis. At other times the exudate is very thin and is easily coughed up. I was wondering whether that might possibly be an explanation.

Dr. Holmes. I think that is an interesting suggestion. I do not know how much weight has been given to it. I purposely avoided a discussion of the etiology because there is already in the literature much better work on that than I could possibly produce and it would mean more work than I have done. There are two things that are suggestive; that is, in the cases reported by Pasteur which follow diphtheritic paralysis, there would be no reason to suppose that those patients had an inflammatory condition in their lungs; they might have had exudate from the fact that they were not using the lung. It also occurs in cases operated on under a local anesthetic. Why should it not occur sometimes in operations on the neck and head if due to an exudate? Those are only suggestions and I do not want to answer them.

Dr. D. R. Bowen, Philadelphia. Working with Dr. Jackson, I had one case which showed conclusively the plugging of a bronchus. This child inhaled the bulb from an electrically lighted tungsten compressor, which plugged the left bronchus. The first picture was exactly that of a huge hydrothorax, except that there was no displacement of the heart. The bulb was taken out and within fifteen minutes we got another plate. In the meantime there had been the most profuse discharge of thin mucus; then we could see the heart shadow plainly and the negative shadow of the bronchial tree where it had emptied out first. The plugging of that lung filled it with fluid and did not collapse it.

Dr. H. K. Pancoast, Philadelphia. I might suggest changing the name forced upon us, to what I think is a much better term for these cases; that is, massive "atelectasis" of the lung, and not "collapse." This condition does not necessarily have to follow operation. I saw one case recently, and I am sorry that I cannot recall the exact clinical aspect of the case, but we examined the man for some condition of the lung which I could not diagnose accurately. I did not know whether he had pneumonia or a new growth. He became very ill and we took the apparatus to his room to examine him. I thought he had massive effusion in the lung. Two or three days later he came to the laboratory and the condition had cleared up. It was due to some unknown cause. Dr. Holmes' case is the only one I know of operated on under a local anesthetic where a general anesthetic was not used.

Dr. Holmes. I think there are other cases in the literature.

Dr. Pancoast. I have seen the plates of 5 of Dr. Leopold's cases. He collected them while in the army and the report of those cases is about to come out in the *Journal of Medical Sciences;* but to my mind Dr. Manges has just explained the situation most satisfactorily.

ATELECTASIS AS A ROENTGEN-RAY SIGN OF FOREIGN BODY IN THE AIR PASSAGES*

BY WILLIS F. MANGES, M.D.

PHILADELPHIA, PENNSYLVANIA

ATELECTASIS or lung collapse is of sufficiently frequent occurrence in connection with foreign bodies in the air passages to warrant our placing some emphasis on this particular sign and discussing its diagnostic value.

Congenital atelectasis was first recognized by Jörg in 1832. Legendre and Bailly in 1844 first recognized the acquired form, and in 1845 Mendelsohn conducted a series of experiments by which he showed that occlusion of the bronchi by foreign bodies results in atelectasis (Lord[1]).

From that time on until the present, the subject has received more or less attention in many of the textbooks on pathology, histology, and other subjects. It is very interesting to see how broadly these various authors treat the subject and the impression is gained that different authors have different views with regard to the condition. There are those who look upon exudate-filled vesicles as atelectatic areas, while others assume that the air vesicles are collapsed because air has not been permitted to enter. Nearly all distinguish between congenital and acquired atelectasis.

There is also a wide variation as to the causes of acquired atelectasis. Of those textbooks examined, Coplin's classification of acquired atelectasis seems to the writer to be the best for our purpose. Coplin[2] speaks of "obturation atelectasis," when the process is due to bronchial obstruction, and of "compression atelectasis," when it is from external pressure.

I submit also the classification of Delafield and Prudden,[3] a very recent publication, in which the term "foreign body" is not specifically mentioned.

The term "atelectasis" does not appear in two English textbooks published in 1923. They speak of "lung collapse" in connection with bronchopneumonia, tuberculosis, etc., but make no mention of "foreign body" (Beattie and Dickson,[4] Donaldson[5]).

A number of authors go more or less into detail on foreign bodies as the cause of atelectasis. Some of these recognize that the foreign body must obstruct the bronchus to inspiration as well as expiration, while others express the opinion that the foreign body acts as a ball valve, permitting air to escape more readily than to enter (Hewlett,[6] Stengel and Fox[7]).

There are a number of isolated case reports of foreign bodies causing atelectasis—some based on post-mortem findings; others on roentgenographic evidence [8,9,10,11,12,13].

The physical signs have been described by Jackson, McCrae and many others.

It is the purpose of this paper to bring the subject to your attention from the roentgenologic viewpoint, and, in the first place, it is necessary to have a clear understanding as to what is meant by the term "atelectasis." When it designates the congenital condition in which the lung fails to become aerated, the term has a definite meaning, but when applied to the acquired form, we have seen that there are varied opinions as to what the term implies. We feel that it should be synonymous with "collapse of the lung" and not be confused with lung that is rendered airless because of an accumulation of exudate. Or, to carry the thought further, when there is atelectasis or collapse, there is definite diminution in the amount of space occupied by that portion of the lung that is atelectatic or collapsed.

Johnson has described the condition known as "drowned lung"—a condition in which there is an accumulation of exudate that drains through the bronchi distal to a foreign body and fills the air vesicles. In this condition, air is entering and leaving this portion of the lung until such time as the air vesicles become completely filled with exudate. There is then no diminution in size and the lung is, therefore, not atelectatic, in the strict sense. If a considerable portion of a lobe, or especially if an entire lobe is involved, then in the presence of atelectasis there must be definite and fixed displacement of viscera, especially of the heart and mediastinal structures and the diaphragm on the affected side. The heart is always displaced toward the side of the lesion (Fig. 1*a* and *b*). This, you will note, is exactly the reverse of the conditions that are present when obstructive emphysema exists (Fig. 2*a*, *b*, *c*, and *d*). When an entire lung is involved, in atelectasis, there is extreme displacement of the heart and aorta, as well as the diaphragm to the affected side. The shadow of the atelectatic lung, so far as the density is concerned, looks not unlike that of extreme consolidation, or of massive thickening of the pleura, pleural exudate of one form or another, or even of massive new growth (Fig. 3*a*). In most of these conditions, differential diagnosis is immediately apparent because, in the vast majority of instances, effusions, consolidations, massive new growths, etc., produce displacement of the heart and mediastinum toward the unaffected side—just the reverse from atelectasis of the obturation type. In one of these conditions, however, that of massive thickening of the pleura or extensive lung fibrosis following infection, the displacement of the mediastinum and the density of the shadows may resemble obturation atelectasis to such an extent that, from the roentgenograms alone, one cannot make a differential diagnosis, and if the history is of long standing, it may be extremely difficult to differentiate between atelectasis of the obturation type and collapsed lung or atelectasis due to compression or fibrosis.

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* Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 24–26, 1924.

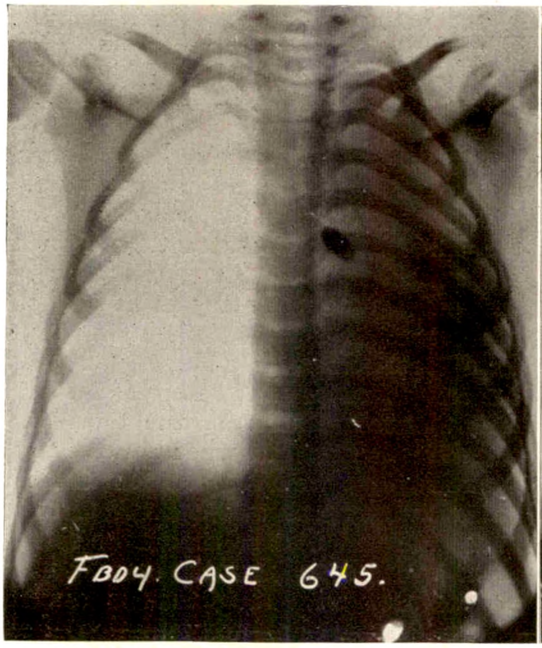

Fig. 1*a*. Atelectasis entire left lung due to inspiratory obstruction of left main bronchus.

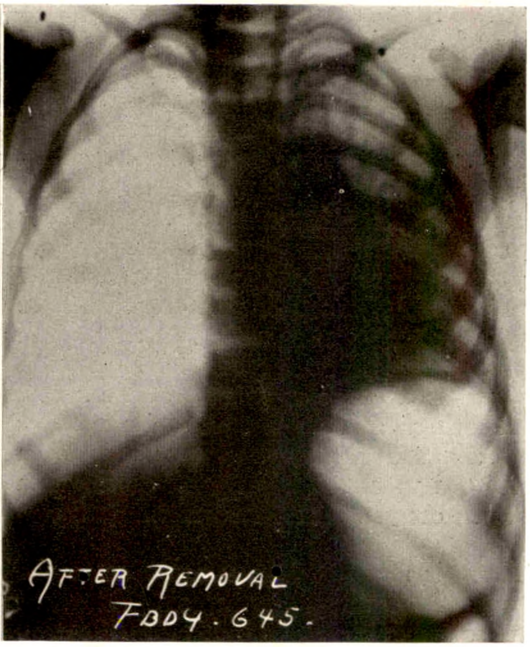

Fig. 1*b*. Ten minutes after removal. Note that considerable air has entered the left lung.

Approaching the subject from another angle, let us say that atelectasis ensues when a bronchus or one of its branches is completely obstructed and when there is not sufficient exudate distal to the obstruction to fill the air spaces. In this case, the air is absorbed and the lung collapses. But we would particularly emphasize our belief that atelectasis does not ensue until such time as the obstruction is complete to inspiration, and, further, that if the obstruction is only almost complete, then instead of atelectasis we will have over-distention with air beyond the obstruction (Figs. 4, 5, and 6). The appearances of the roentgenograms of these two conditions are diametrically opposite. Instead of density, there is increased transparency on the affected side and the viscera, instead of being displaced toward the affected side, are displaced away from it. We believe that this is true whether the obstruction is due to a foreign body within the bronchus or whether it is due to compression of a bronchus by a localized mass, such as an enlarged gland or a localized new growth. In the case of obstruction by a foreign body, the shadow of the atelectatic lung will be more or less sharply limited by its pleural covering, and will be distributed along the line of the interlobar fissure. When one lobe is involved, then the fissure will change its relation somewhat with

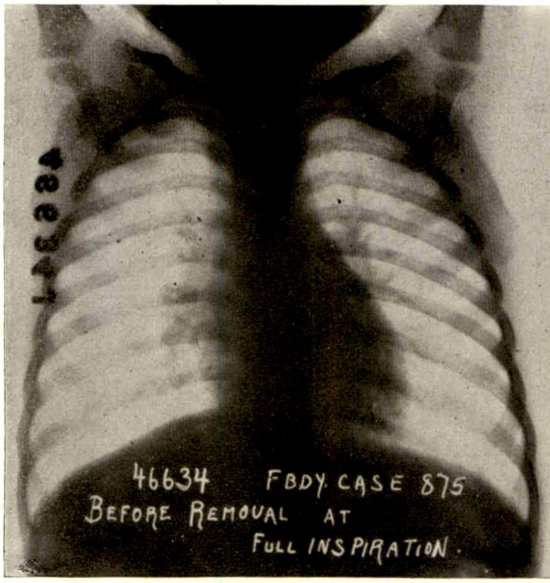

Fig. 2*a*. Typical case of obstructive emphysema due to inspiratory obstruction right main bronchus by peanut kernel. Inspiration.

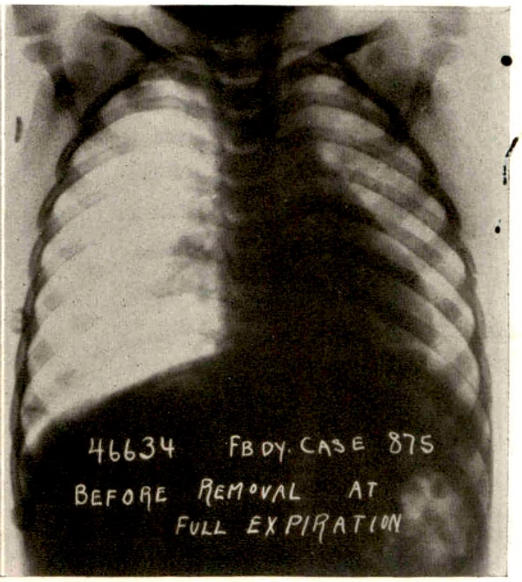

Fig 2*b*. Expiration before removal.

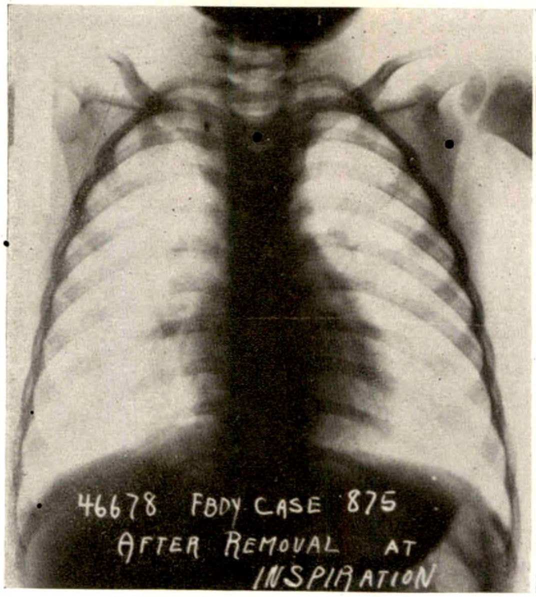

Fig. 2*c*. Inspiration.

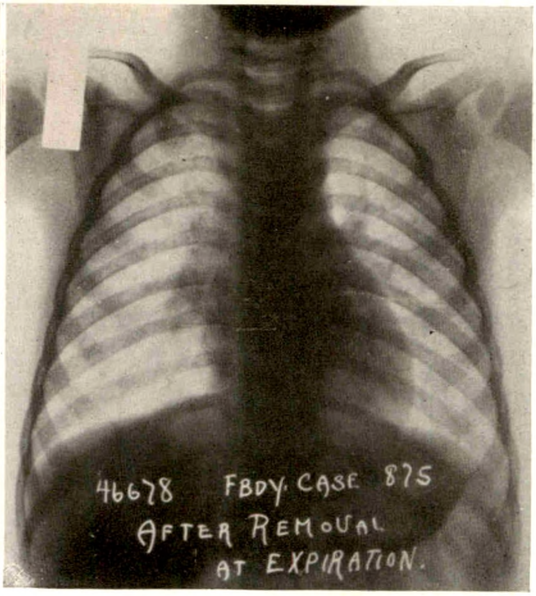

Fig. 2*d*. Expiration after removal.

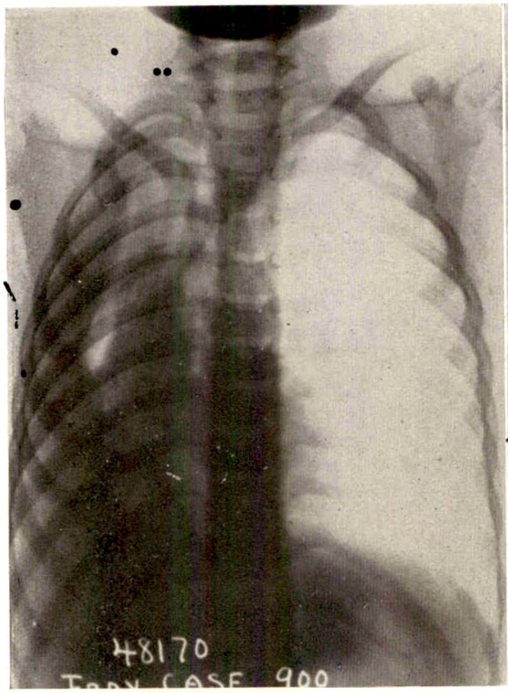

Fig. 3*a*. Atelectasis right lower and middle lobes, partial atelectasis right upper lobe, due to bean in right bronchus producing obstruction to inspiration.

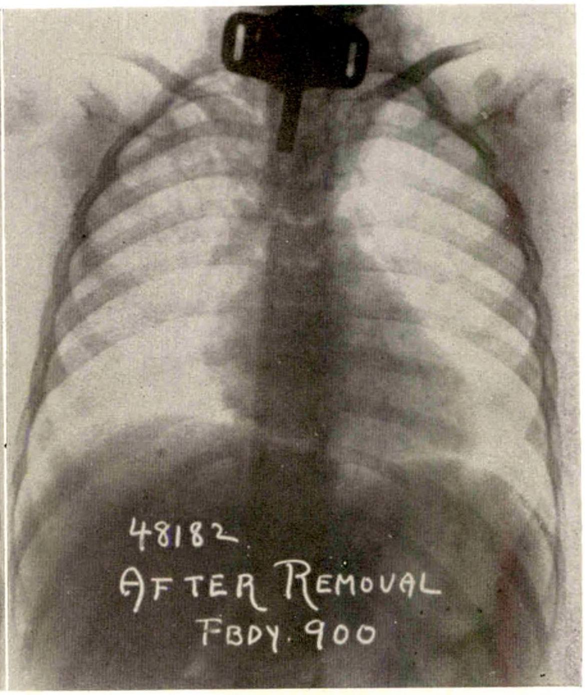

Fig. 3*b*. Complete reaeration of entire lung a few hours after removal of foreign body.

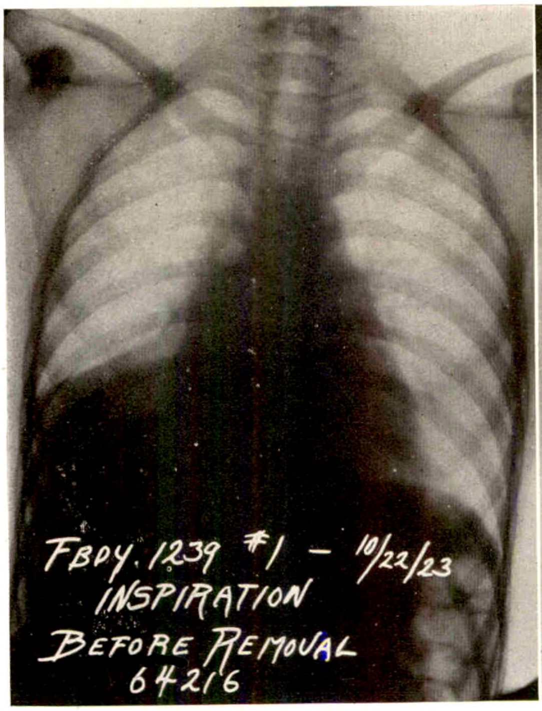

Fig. 4*a*. Atelectasis right lower lobe due to prune stone producing inspiratory obstruction, right lower lobe bronchus. Inspiration.

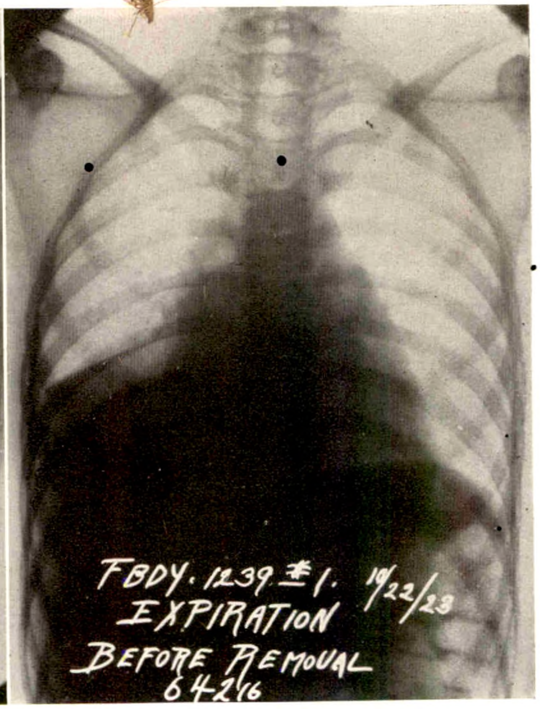

Fig. 4*b*. Expiration before removal.

regard to the chest wall. In the case of compression by enlarged glands or growth, if the compression makes complete obstruction, then, in addition to the density of the atelectatic lung, one has to consider the tumor mass also, in which case the lines will not necessarily be in the distribution of an interlobar fissure.

When atelectasis involves the right lower lobe or the lower and middle lobes, it is fairly easy to recognize, because the line of density is downward and outward from the root area and the shadow of the diaphragm is lost in the density of the collapsed lung. This, too, is the best sign in differentiating between atelectasis and fibrosis from chronic infection of the lung and pleura. When the left lower lobe is involved, there is more difficulty because the heart adds its mass, and then, too, the interlobar fissure on the left side is long and oblique from above and behind downward and forward, and displacement of the heart to the left is the only striking feature.

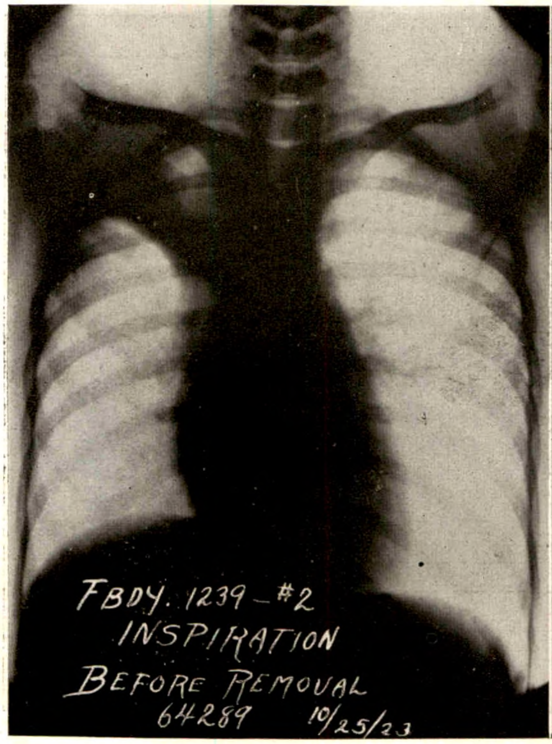

Fig. 5a. Same case as Fig. 4. The foreign body has shifted into the right upper lobe bronchus producing inspiratory obstruction to upper lobe and expiratory obstruction to middle and lower lobes. Inspiration.

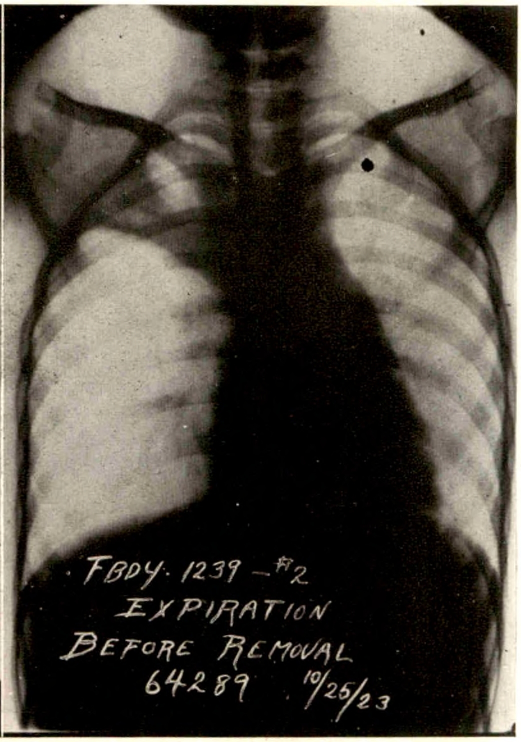

Fig. 5b. Expiration before removal. Note change in diaphragm and heart between inspiration and expiration.

We have noted before that there may be a mixture of "drowned lung" and atelectasis present in the same lobe, and, in a number of instances, the same foreign body has produced obstructive emphysema in one portion and atelectasis in another portion of the same lung. We have also seen cases in which the same foreign body produced atelectasis in one portion of the lung at one time and at a different portion of the same lung at another time. These changes, of course, are due to change in position of the foreign body.

We know of only one case in which there was obstructive emphysema of the upper lobe and atelectasis of the lower lobe in which there was not a foreign body present, and that was in the case reported by Phillips and Lafferty.[14]

In this case there was congenital narrowing of the branches of the left upper lobe bronchus to such an extent that there was obstructive emphysema of the upper lobe and complete compression atelectasis of the lower lobe.

In the presence of a history of aspiration of foreign body and in the absence of any history of chronic infection of the lung or pleura, we believe that a collapsed lobe with displacement of the mediastinal structures to the affected side is positive evidence of foreign body, whether the latter casts a distinguishable shadow or not. In the absence of a history of aspiration, it is evidence of bronchial obstruction and if the appearance is not explained by some concurrent condition, we believe that a diagnosis of foreign body is strongly probable; it at least indicates a need for bronchoscopic study.

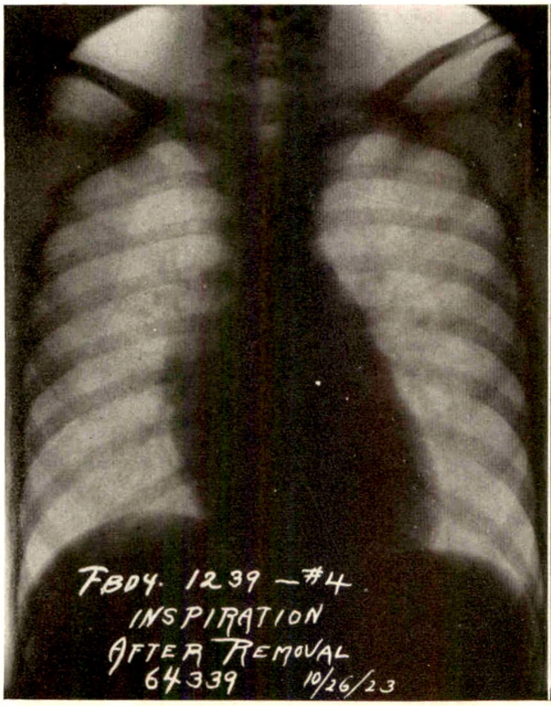

FIG. 6*a*. Same case as Figs. 4 and 5. Inspiration.

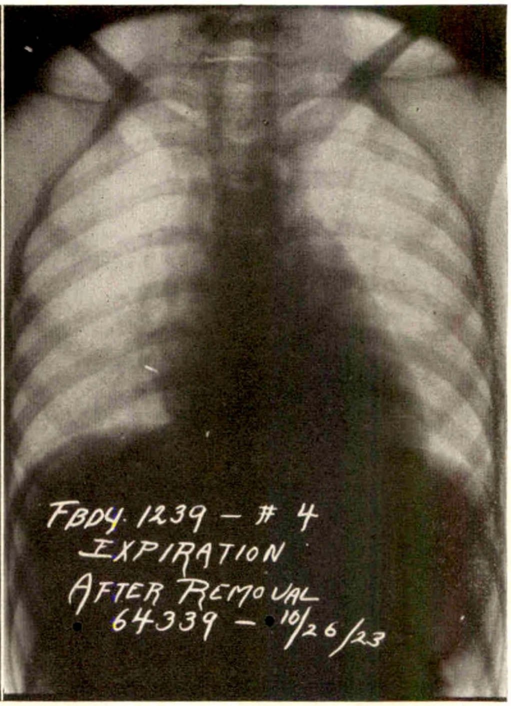

FIG. 6*b*. Expiration twenty-four hours after removal of foreign body. Relations and lung shadows are normal.

Briefly, the roentgenographic appearance of atelectasis is extreme density in the affected lung, the distribution following more or less the line of interlobar fissures, displacement of the heart and other mediastinal structures toward the affected side, and elevation of the diaphragm on the affected side.

I am indebted to Dr. Jackson for permission to present this subject from material obtained through the Bronchoscopic Clinic at the Jefferson Hospital.

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OSTEOMA OF THE SPHENOID BONE AND DURAL ENDOTHELIOMA: REPORT OF A CASE

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THE association of an osteoma of the skull and an over- or underlying dural endothelioma is so common as no longer to be regarded as a pathologic curiosity. The case reported here is unusual because of the location of the osteoma, and the roentgenologic findings.

Case I. (A441665). A salesman, aged forty-five, came to the Clinic September 18, 1923, complaining of vertigo and failing vision. Nine months before, he began to have headaches, which started at the base of the head and radiated over the entire skull. The headaches occurred about three times a week, persisted for from three to four hours, and were followed by attacks of vertigo, lasting but a few minutes. Four months before examination, vision in the left eye began to fail, and two months later in the right eye, the condition of which gradually became worse than that of the left. The patient's general health otherwise had been good.

Examination revealed bilateral irregular pupils, and bilateral choked discs; there was no nystagmus. The Bárány test was positive, but did not localize a lesion. A roentgenogram of the skull disclosed erosion of the sella and destruction of the posterior clinoid processes. The neurologic diagnosis was unlocalized brain tumor.

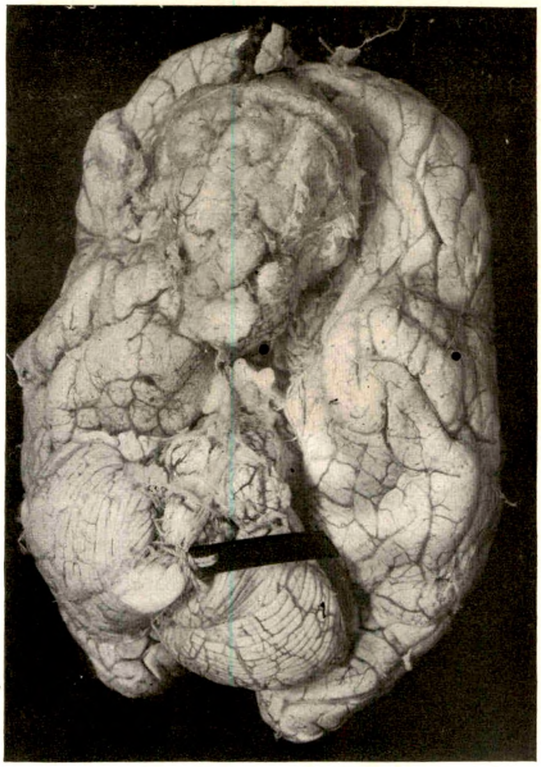

Fig. 1. Necropsy specimen of tumor, and its relation to the inferior surface of the frontal lobes.

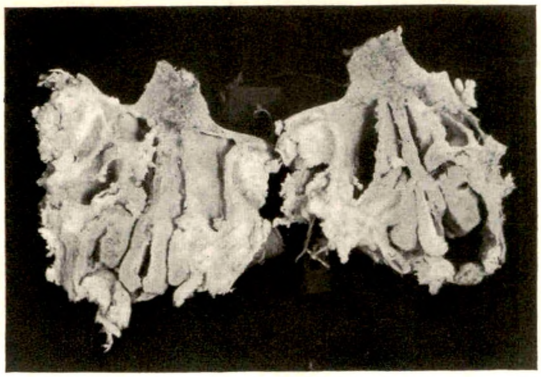

Fig. 2. Necropsy specimen; a coronal section through the osteoma and sphenoid bone.

A ventriculogram was attempted, but since only 5 c.c. of fluid was obtained through the posterior horn of each ventricle, no air was injected. One week later a craniotomy was performed, and the right temporosphenoid area explored. A mass, approximately 5 by 7.5 cm. in diameter and 1.3 cm. below the surface, was encountered, which was believed to be attached to the dura, inferior to the frontal lobe and to extend backward into the temporosphenoid lobe, probably an inoperable endothelioma. The patient died twelve days after the operation.

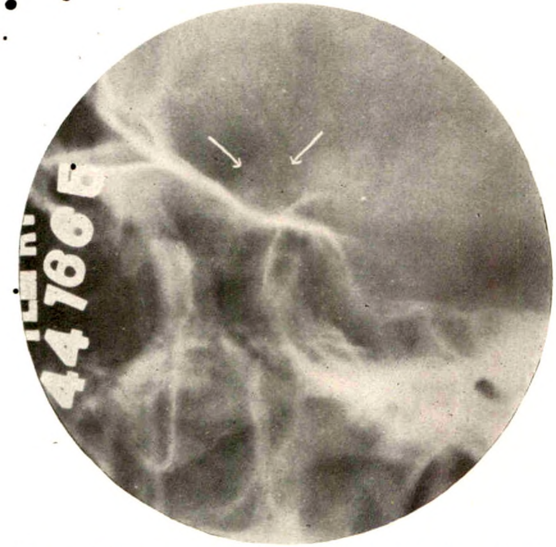

FIG. 3. Roentgenogram indicating destruction of sella and posterior clinoid processes. Arrows indicate shadow of osteoma.

At necropsy, as the frontal lobes of the brain were reflected, a firm, pink, irregularly rounded tumor, 7 by 6 by 4.5 cm., firmly attached in the median line to a bony projection on the superior surface of the sphenoid bone, was revealed (Fig. 1). The anterior surface of the mass exhibited numerous small nodules from 3 to 5 mm. in diameter. The tumor had pressed upward on the inferior surface of the frontal lobes where it had produced a well-marked concavity corresponding to the upper half of its mass. The supraorbital plates of the frontal bone were found to be eroded and partially absent on both sides, especially the right, and the retrobulbar fat was plainly visible. Behind the crista galli was found a bony projection, 6 mm. in diameter and 2 cm. in height, to which the base of the tumor was attached (Fig. 2). No definite involvement of the dura could be demonstrated, except around the peak of this bony eminence. The sella turcica was eroded, and the posterior clinoid processes and dorsum sellae were almost completely destroyed.

On further study of the roentgenograms, in view of the necropsy findings, the shadow of the osteoma, which had been overlooked at the first examination of the films, could be plainly seen (Fig. 3). The extreme destruction and flattening of the sella in the roentgenogram, without other roentgen signs of increased intracranial pressure elsewhere in the skull, are more than suggestive of a tumor at the base of the brain, and in this instance such a discovery by the roentgenologist might have been of considerable assistance to the clinician in his endeavors to localize the neoplasm.

COOLIDGE TUBE QUANTITATIVE VARIATIONS

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COOLIDGE and Kearsley[1] have demonstrated that the energy output from different Coolidge tubes, operated under identical conditions, varies considerably. Quantitative estimation was determined by means of ionization, the most sensitive and, when properly done, the most accurate method of measuring roentgen radiation. The quantitative discrepancies are thought by them to be caused by variation in thickness of the glass walls of individual tubes. This difference in wall thickness affects variation of quality as well as of quantity. For the present purposes, however, the former interests us only as a modifier of the latter when measured by ionization, or by methods of estimation used in practice.

A brief synopsis of the results obtained by Coolidge and Kearsley[2] is herewith appended:

Twenty "high-voltage" Coolidge tubes operated on 200,000 volts, without filtration, showed an average percentage deviation from the mean of 9.6. The extreme difference between any two tubes in this series was 87.5 per cent. With a filter of 0.2 mm. Cu. the average deviation from the mean was 1.25 per cent, and the maximum variation between tubes was 5.5 per cent.

A series of 7 broad focus "universal" Coolidge tubes operated under conditions usual in deep therapy—127,000 volts, or about a 9 in. blunt point spark-gap—showed without filtration: an average deviation from the mean of 10.2 per cent; with a filter of 3 mm. Al., 3.55 per cent. With 10 medium focus "universal" tubes the average deviation from the mean was 6.5 per cent without filtration and 2.48 per cent with filtration.

In the combined series of 17 tubes of "universal type" (broad and medium focus) the extreme difference between individual tubes was 66.5 per cent without filtration, and 12.9 per cent with filtration (3 mm. Al.; 9 in. blunt point gap).

With the lower voltage it was determined that there was a greater difference between individual tubes. Deductively, it might be inferred that individual variations would be still greater with a 6 in. spark-gap, which is the spark-gap length most commonly used when treating skin diseases.

It was thus shown that there is considerable difference in the output of unfiltered radiation from individual Coolidge tubes of "high-voltage" and "universal" types as estimated by ionization. The extreme difference between any two tubes was as high as 87.5 per cent. With a filter of 3 mm. Al. the maximum discrepancy between individual tubes was 12.9 per cent.

At first thought these findings are perturbing to those who use unfiltered radiation. Upon reflection, however, it is realized that unfiltered roentgen radiation has been used in heavy therapeutic doses for many years by numerous dermatologists and roentgenologists, dosage being estimated by the usual practical methods, with results that show satisfactory uniformity. In recent years indirect technique (estimation of quantity by milliamperage, spark-gap, time and distance) has been universally employed in this country. Unexpected reactions are very uncommon and when they do occur an error of technique or of judgment can usually be detected. Even in the roentgen treatment of tinea tonsurans, where the latitude of safety is comparatively slight, the consistent results have been very satisfactory. With the indirect technique in general use among dermatologists it is possible to duplicate skin reactions, pastille reactions and photographic reactions. In other words, the unfiltered technique of recent years has been so reliable as to cause the erroneous assumption that emission of energy from every Coolidge tube of "universal" type, operating under identical conditions, is approximately the same.

The subjoined experiments were made in an attempt to ascertain if energy variations from different "universal" Coolidge tubes could be detected by skin effects.

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[1] COOLIDGE, W. D., and KEARSLEY, W. K., Jr. High voltage x-ray work. AM. J. ROENTGENOL., 1922, ix, 77–101.

[2] Ibid.

Experiment No. 1. The patient was a female; blonde; aged forty. The flexor surface of the forearm was selected for the test. Five areas, 4 square centimeters in size, were exposed, a different "universal," medium focus, Coolidge tube being used for each exposure. For purposes of designation and identity, the areas and tubes were given corresponding numbers (Chart 1). The apparatus consisted of a 10 kw. interrupterless transformer; rheostat control; blunt point spark-gap; direct current. The filament current was obtained from a step-down transformer and small rotary, and controlled by a choke coil. Two milliamperemeters in series were used; there was no voltmeter. The needles of the milliamperemeters did not perceptibly fluctuate during the five exposures. The factors or constants employed were: 3 ma.; 6 in. spark-gap; a skin-target distance of 8 in.; exposure time, 2 min. and 30 sec. timed with a stop watch. The radiation was unfiltered.

The test areas were exposed on July 21, 1922. The first evidence of a skin reaction was noticed seven days later, at which time there was a very faint flush in areas 1 and 4. After rubbing the skin, applying hot towels, and waiting until the general reaction subsided, all the areas depicted a definite but faint erythema, which was slightly greater in areas 1 and 4.

On August 5, fifteen days after the exposure, there was a faint but definite erythema in each area. It was no longer necessary to apply friction and heat to make the areas visible. Areas 1, 4 and 5 were a little more conspicuous than their neighbors.

On August 10, twenty-five days after exposure, the reactions had reached the maximum. There was no edema; no vesiculation; nothing but a mild degree of erythema. Each area was distinctly visible; areas 1, 4 and 5 were slightly more conspicuous than areas 2 and 3. The reaction in the latter was never quite as intense as in the former. The erythema remained unchanged until August 18, twenty-one days subsequent to its appearance, when it began to fade gradually.

By August 25, forty days after exposure, the erythema had entirely disappeared from areas 2 and 3: these areas could be made visible with friction or heat. The other areas were very faint, area 1 being the most prominent.

On September 1, areas 2 and 3 were invisible, even after the application of friction and heat; areas 4 and 5 were visible only after the use of heat or friction. There was still a very faint erythema in area 1, which had entirely disappeared by September 15, sixty-six days after exposure. The last observation was made on November 13, at which time there was no erythema, atrophy nor pigmentation, nor could the areas be made visible by friction or heat.

Experiment No. 2. This experiment was a duplication of the first experiment, except that a different patient and a different series of five tubes were used (tubes Nos. 6 to 10 inclusive, Chart 1) making ten tubes in all. The patient was a female, blonde, aged sixteen. Utilizing the same apparatus and the same factors, five small areas on the flexor surface of one forearm were exposed to unfiltered radiation on August 20, 1922. Five days later a faint erythema of equal intensity appeared in each of the five areas.

On August 28, eight days after exposure, the erythema had increased, the areas being more clearly defined. The reaction in each area appeared to be of the same degree of intensity. The erythema continued to increase until maximum development on September 25, thirty-six days after exposure. The reaction in each area was of equal intensity so far as could be ascertained by inspection and palpation.

On October 6, the areas were hardly visible, each one being the same. On October 22, sixty-two days after exposure, the erythema had disappeared but each area was slightly pigmented, the intensity of tanning, so far as could be judged, being the same in each area. On December 22, all pigmentation had disappeared and there were no sequelae such as atrophy or telangiectasia. This was verified six months later, on June 29, 1923.

Experiment No. 3. This observation was made on a boy, aged seven, who

CHART I

Tube No.	Ionization readings	Clinical experiments							
		1		2		3		4	
		Area	Reaction	Area	Reaction	Area	Reaction	Area	Reaction
1	9.0	1	Strong	..	....	Occiput	Strong	1	Moderate
2	0.0	2	Weak	..	....	Vertex	Strong		
3	14.2	3	Weak	..	....	R. parietal	Moderate	3	Weak
4	12.4	4	Moderate	..	....	Frontal	Weak	4	Moderate
5	12.0	5	Moderate	..	....	L. parietal	Moderate	5	Weak
6	10.0	..	....	1	Moderate	....	....	2	Strong
7	10.4	..	....	2	Moderate				
8	10.8	..	....	3	Moderate				
9	10.0	..	....	4	Moderate				
10	12.1	..	....	5	Moderate				

NOTE: Tube No. 2 was broken before being tested by ionization. Ionization readings represent time in seconds to discharge 4 ionization units. In all instances the reaction consisted of only a slight but definite erythema, or partial or complete temporary alopecia without erythema: therefore, terms used to indicate degree of reaction are of value only as comparatives.

had disseminated ringworm of the scalp. The hair was brown, coarse and oily. There were numerous dime to quarter-sized scaly, erythematous patches with broken hairs, scattered over the scalp. Pustules were present in some of the patches. The diagnosis was confirmed by microscopical examination.

The scalp was divided into five areas in accordance with the Kienböck-Adamson method. To each area was administered an epilating dose of unfiltered roentgen rays. The apparatus was the same as that employed in the first and second experiments. The constants were the same with the exception of time, which was reduced to two minutes. A different tube was used for each area. The tubes were those employed for Experiment No. 1. The treatment was administered on August 11, 1922.

On August 26, fifteen days after the treatment, the hair of the entire scalp was loosening and beginning to fall. On August 29, the hair was falling out; the epilation seemed to be about the same over the entire scalp.

The patient was observed a number of times between August 29 and September 18. The epilation in all but the anterior area was complete by the last date. There was very little hair in the anterior area, but the defluvium was not so complete as in the other areas; also the defluvium had not been so rapid in the anterior area.

On September 18, thirty-eight days after the treatment, hair was beginning to grow in the anterior area. On September 23, hair was beginning to grow all over the scalp. On September 30, it was noted that the hair was growing most rapidly in the anterior area, and slowest on the vertex and in the posterior area.

On November 11, three months after the treatment, the hair was growing rapidly over the entire scalp; it was as thick as it had been before the treatment, and of the same texture, color and general appearance. It was one inch in length in the anterior area and one-half inch in length over the rest of the scalp. At no time had there been any visible roentgen reaction other than the falling of the hair. The disease was cured.

Experiment No. 4. This was a duplication of Experiments Nos. 1 and 2: The constants or factors, the dose, and the site were the same. The patient, a woman, aged twenty, was slightly brunette. Of the tubes employed, four had been used in the first and one in the second experiment. The skin areas were numbered in correspondence with the tubes (Chart 1).

The five exposures were made on March 11, 1922. On March 17, a slight but definite redness was noticeable in each space. This was of equal intensity except that area 3 was a little less conspicuous than its neighbors. On March 23, the erythema was a little more pronounced; area 3 was still less perceptible than its contemporaries. On March 26, areas 1 and 4 were the strongest tinctorially; No. 3 was the weakest; No. 5 was beginning to fade in the center. On March 28, seventeen days after irradiation, and eleven days subsequent to the appearance of a very mild first-degree radiodermatitis, the erythema of all areas was less, but the relative intensity was unchanged. On April 5, area 3 depicted faint pigmentation, but no erythema. The other spaces were of a dull red color: No. 2 was the most prominent; Nos. 1, 4 and 5 were about equal in intensity. On April 10, Nos. 1, 2 and 4 still showed erythema; Nos. 3 and 5 were free of redness. On May 4, Nos. 1, 2 and 4 were faintly red, intensity being about equal. On May 14, all erythema had entirely disappeared. Each area was slightly pigmented, the degree of pigmentation being approximately the same in each, with the exception of No. 3, which depicted less color than its fellows. On June 6, the last observation, there was still a little pigmentation, but it was diminishing.

COMPARISON OF SKIN EFFECTS AND IONIZATION RESULTS

In the first clinical experiment, there was a very slight comparative difference in the degree of visible reaction. The most pronounced response was in area 1. Here, the erythema began a little sooner, was a trifle more intense, and endured a little longer. Tube 1, used for this area, gave the highest energy output, as estimated by ionization, of any of the ten tubes employed for the four experiments (Chart I). The reading for this tube was 9 seconds. Area 3 depicted a relatively weak reaction; and Tube 3 gave an ionization reading of 14.2 seconds, the lowest efficiency recorded. The percentage difference between these two tubes is 57.8.

In the second experiment, the reaction in each space was the same so far as could be discerned by visual and tactile observation. In this instance there was relatively little variation of energy emission, as estimated by ionization, among the individual tubes (Chart I). The ionization time for tube 10 was 12.1 seconds, while the other five tubes registered readings ranging from 10.0 to 10.8. The percentage difference between the extremes is 21.

In the third experiment, the clinical results would indicate that the frontal area had received a slightly smaller dose, and the occiput an inconsiderably larger amount than the remainder of the scalp. Tube 1, used for the occiput, gave the strongest of all ionization results (9.0). It was this tube, also, that evoked the most conspicuous reaction in the first experiment. Tube 4, with an ionization reading of 12.4, was utilized for the anterior portion of the scalp. There was no detectable difference in the defluvium of the two parietal regions, yet the tube used for the left parietal area gave an ionization reading of 12.0, while the tube employed for the opposite side of the head recorded a reading of 14.2. It may be interjected that the consensus of dermatological opinion is that all parts of the scalp are of equal "radiosensitiveness" except the vertex, which is comparatively tolerant.

In the fourth experiment, area 3 gave clinical indications of having received the smallest dose, which corresponds with the ionization record of tube 3 (14.2). This tube caused, also, the weakest clinical reaction in the first experiment. Tube 1 provoked a fairly strong clinical response and this tube, which recorded the highest energy output, as estimated by ionization, produced relatively strong reactions in experiments Nos. 1 and 3 (Chart I).

CONSIDERATION OF IONIZATION RESULTS

Our ionization results differ from those obtained by Coolidge and Kearsley.[1] They determined a maximum intensity variation of 87.5 per cent with unfiltered radiation, and only 12.9 per cent with a filter of 3 mm. Al. We obtained a maximum difference of 57.8 per cent with unfiltered radiation, and 75.7 per cent with 3 mm. Al. (Chart II). Variations in clinical reaction agreed, to a certain extent, with the energy output as estimated by ionization; that is, the tube recording the highest efficiency, effected the most pronounced reaction, and vice versa.

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[1] Loc. cit.

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CHART II

Tube No.	Ionization time in seconds*			Unfiltered	3 mm. Al.
	Unfiltered	3 mm. Al.			
1	9.0	14.8	Average time in seconds	11.2	20.5
3	14.2	22.3	Average percentage deviation from mean	11.5	12.2
4	12.4	21.2	Maximum percentage deviation from mean	26.7	27.8
5	12.0	23.7	Maximum percentage difference	57.8	75.7
6	10.0	18.0			
7	10.4	26.0			
8	10.8	20.3			
9	10.0	18.4			
10	12.1	19.8			

Constants

Unfiltered	Filtered—3 mm. Al.
Ma. 3	Ma. 5
Sp. G. 6 in.	Sp. G. 8 in.
Dist. 8 in.	Dist. 10 in.

*Time in seconds to discharge four ionization units.

There are several possible explanations for the difference between our findings and those recorded by Coolidge and Kearsley, a few of which are herewith enumerated. In the first place, in point of accuracy, our work is not comparable with theirs. Their work was done by trained physicists in a well-equipped scientific laboratory. Our work was conducted with an iontoquantimeter, in a therapeutic laboratory, by practicing physicians. We are cognizant of the possible errors associated with ionization measurement and, so far as knowledge and conditions would permit, such errors were avoided. We believe that our work was carried out with as much precision as may be obtained with apparatus designed for practical use. We noticed discrepancies in the routine experimental results which could not be avoided. These were ascribed to variations of line voltage, to errors in timing, in estimating spark-gap lengths, to iontoquantimeter leakage, etc. The ionization experiments were done over and over again during a period of several months. Each ionization numeral herein tabulated represents the average of a large number of consecutive readings made on the same day and under the same conditions of temperature, humidity, atmospheric pressure, ventilation, fixed electrical factors, etc.

The iontoquantimeter employed by us is of American manufacture. It consists of a static charger, an electroscope and an ionization chamber. The charger and the electroscope are enclosed in a box, which is encased in lead of a thickness sufficien to prevent the passage of secondary and scattered rays. The air in the housing is kept dry by a small amount of calcium chloride. The instrument is thoroughly grounded to prevent accumulation of static. The electroscope and the conducting wire leading from the electroscope to the ionization chamber are adequately insulated. The wire passes through a grounded, flexible metal tube four feet in length. The wire is surrounded by insulating material which occupies the entire lumen of the tube: there is no air in the tube. The wire projects from the end of the flexible tube and is covered with a small cap composed of keratin 1 mm. thick, which is electrically connected to the flexible tube. The interior of the keratin cap constitutes the ionization chamber. When roentgen rays enter the chamber the air is ionized, current passes from the wire to ground and the electroscope is discharged. A window composed of thick lead glass, in the housing, permits a view of the electroscope. The fall of the leaf over the scale is timed with a stop watch. When the electroscope is charged, the leaf will maintain its position for several hours even in a room where roentgen rays are being constantly generated, provided, of course, that the ionization chamber is suitably protected. When in use, the ionization chamber is placed directly under the anode and the housing containing the electroscope is placed beyond the field of direct radiation.

Because all the radiation measured by us by ionization passed through the 1 mm. keratin cap of the ionization chamber, it was, although unfiltered by other substances, at least filtered by the keratin, so that we really did not employ any truly unfiltered radiation. This may explain why our results were much the same with both filtered and unfiltered radiation. It does not, however, explain the marked maximum difference between tubes obtained with filtered radiation. We understand that the unfiltered radiation used by Coolidge and Kearsley passed through a thin sheet of mica.

We used a 6 in. spark-gap for unfiltered radiation, and an 8 in. spark-gap for filtered radiation, while Coolidge and Kearsley employed a 9 in. spark-gap for both filtered and unfiltered radiation. We utilized lower voltage so as to conform to conditions in actual dermatological practice and because, under these conditions, the variations in output from different tubes are more pronounced. Coolidge and Kearsley were careful to have all the radiation from the focal point enter the ionization chamber; and the electrodes of the ionization chamber were not in the field of radiation. In our work the tube was placed in a lead-lined receptacle, the under surface of which was fitted with an adjustable diaphragm. The filters were placed in the diaphragm. The small ionization chamber was placed on wood, at the desired distance, directly under the anode.

The lower voltage, and the fact that we used a small ionization chamber placed in the direct beam of radiation, might explain to some extent, the difference between our results and those of Coolidge and Kearsley. They found that the radiation is "least penetrating in a direction normal to the face of the target and that the penetrating power increases on both sides of this direction as glancing incidence is approached." This position of the ionization chamber was intentional, as such position approximates conditions in actual practice.

As previously stated, we did not employ a voltmeter; nor did we use a stabilizer. The filament current was subject to fluctuations of line voltage, but it was controlled by a very sensitive choke coil. We enjoy a reasonably steady source of current supply. The needles of the milliamperemeters were held steady without difficulty. Our ionization results are presented, not as a standard, but simply as a check on the clinical experiments.

DISCUSSION

Of greater interest are the results of the clinical experiments with unfiltered radiation. The maximum difference in unfiltered energy output between tubes in our series, as estimated by the iontoquantimeter, was 57.8 per cent. This difference is sufficient to produce alarm in the minds of practical workers; and yet the difference in visible skin reactions, even with large doses, is almost imperceptible.

In this connection, it might be well to interject a word of caution relative to the significance and interpretation of visible skin effects. One must guard against the influence of age, sex, texture and color of skin, idiosyncrasy, location, irritating topical applications, effect of disease, condition of the skin, etc. It should be realized that visible "skin effect" is not synonymous with biological reaction; it is simply a single, visible feature of a complex biological reaction which may extend to a considerable depth, and which may be associated with degenerative changes that may not be manifest for many months. Because of difference of penetrability, or of ability to be absorbed by superficial tissue, the significance of a certain degree of reaction for filtered radiation differs from that for unfiltered radiation. It is often difficult to correlate clinical reactions with estimated dosage. After erythema develops to a certain degree, a more intense reaction may not result in perceptible tinctorial change; it may be manifested by edema and subjective sensations. It is possible for the skin to remain at about the same degree of erythema and edema for several weeks under the influence of repeated irradiation, and then it may ulcerate or depict evidence of degeneration. It is also difficult to record and even to compare reactions, as there is no color standard nor standard of inflammation, with which to aid memory, or which may serve as a check on clinical observation.

Because of the variation in tube output and because, as determined by Coolidge and Kearsley, this is lessened by the use of a filter, many dermatologists and roentgenologists are advocating filtration, as a routine, for the treatment of skin diseases. It is not within the scope of this article to discuss the advantages and disadvantages of filtered radiation as a routine in superficial roentgenotherapy. Suffice it to say that unfiltered radiation is considered desirable for many dermatological conditions; that variations in degree of skin reaction with different Coolidge tubes, operating under like conditions, are almost imperceptible with both filtered and unfiltered radiation; that iontoquantimeter experiments show a marked difference in output from different tubes even with filtered radiation; that it is not necessary, for the purpose of safety, to use a filter to equalize the output from various Coolidge tubes; that the unfiltered roentgen technique employed in this country for superficial work is satisfactory, efficacious and safe. It seems hardly necessary to add that the use of roentgen rays for therapeutic purposes, regardless of technique, should be associated with a high degree of skill, diligence and judgment.

In the absence of experience to the contrary, it naturally would be supposed that an extreme difference of 60 or 80 per cent in tube output would preclude the use of unfiltered radiation. What is the explanation? Practical technique has been developed, standardized and controlled with the aid of pastille and photographic radiometers and by visible skin reaction. Compared with the accurate and sensitive ionization method as used by physicists, most practical methods of estimation are crude, insensitive and inaccurate. It seems that a difference of 50 per cent or more, as estimated by ionization, is hardly detectable by the customary practical methods of dose estimation; and this includes visible skin effects. Of late years, with more precise technique and greater biological knowledge, such as the causes for hypersensitiveness, hyposensitiveness, etc., it has been realized that the margin of safety is much greater than was formerly supposed. Since the publication of the invaluable article by Coolidge and Kearsley this realization has been strengthened. It is indeed fortunate that this very great margin of safety has existed, for otherwise the evolution of roentgenotherapy would have been tremendously retarded.

In our clinical work of the past, with erythema and epilating doses, we have occasionally noticed that the clinical response as estimated by erythema or epilation, in spite of careful technique, would be a little greater or a trifle less than was expected. This was ascribed to slight errors of technique, such as variable voltage, miscalculation of distance, or of spark-gap length, faulty judgment, etc. Undoubtedly many of these clinical discrepancies were due to such causes, but in the light of present knowledge, some variation in clinical response must be expected unless the proclivities of each tube are known, and it is advisable for the operator to acquire such knowledge.

The fact that unfiltered technique has been found sufficiently reliable for practical purposes, should not lessen efforts for increased accuracy. Presumably it is impossible to standardize wall thickness of Coolidge tubes. It might be practicable for the manufacturer to classify each tube according to energy output as estimated by ionization. Formerly, dermatologists and roentgenologists used photographic and pastille radiometers to check and standardize technique, and to determine the comparative energy output from different tubes. In recent years, in this country, clinicians have depended on skin effects rather than radiometers. It is now feasible to utilize the more sensitive, accurate and rapid method of ionization to test tubes and technique. For this purpose the iontoquantimeter is a useful instrument, provided one thoroughly understands its operation and appreciates its limitations.

CONCLUSIONS

1. Ionization experiments with an iontoquantimeter show considerable variation of energy output from different Coolidge tubes.
2. Experiments on the skin show a variation of output from different

Coolidge tubes, although, judging from visible skin effects alone, the difference is not great.

3. A difference of energy output amounting to 57.8 per cent (as estimated by ionization) causes very little difference in the visible cutaneous reaction.

4. The manufacturer is urged to classify therapeutic tubes according to ionization estimation of energy output.

5. The indirect technique used by dermatologists in this country is the most accurate yet devised, and it is sufficiently reliable for practical purposes.

Dr. Fred Wise and Dr. Howard Fox each loaned us one tube, a kindness that is much appreciated. We thank Dr. A. F. Kovarik, Assistant Professor of Physics, Yale University, for much helpful advice; and Dr. Blanche Norton, our assistant, who helped with the technical work and clinical observations.

MALIGNANT GROWTHS OF THE PARANASAL SINUSES TREATED BY IRRADIATION, ELECTROCOAGULATION AND OTHER METHODS*

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MALIGNANT growths of the paranasal sinuses are rare, and in consequence the literature concerning these conditions is meager. At the Memorial Hospital, New York City, 1892 cases of cancer were treated in the years 1916 and 1917; 48, or 2.53 per cent involved the paranasal sinuses; 35, or 1.84 per cent involved the maxillary sinuses; leaving only 0.69 per cent involving the other sinuses. At the Mayo Clinic, during a period of two and a half years, 33 malignant tumors were observed in the antra. These malignant growths often produce severe suffering and because of their location and the usually inefficient methods of treatment, are regarded as almost hopeless.

There are many different types of growth involving the sinuses. Ewing classifies them as follows:

(1) Mucosa: Cysts (empyema) mucoid. Cystic myxoma. Fibroma. Epithelial papilloma. Carcinoma.

(2) Bones: Osteoma. Fibro-osteoma. Osteosarcoma. Chondroma.

(3) Ethmoidal sinuses: Fibroma. Osteoma. Carcinoma.

(4) Sphenoidal sinuses: Polypoid myxoma.

(5) Frontal sinuses: Osteoma. Carcinoma.

In addition to these possible growths in the sinuses, in making a diagnosis we must also consider lues, tuberculosis, actinomycosis, and empyema.

The subjective symptoms, which lead the patient to consult the physician, may be the same in all these conditions—pain, itching, burning, or pressure in the cheek or teeth, difficulty in breathing through the nose, an increased discharge or bleeding from the nose, pain in the ear or a frontal headache. To the physician looking for objective symptoms, indeterminate subjective symptoms such as these offer little clue to the real pathology. Although he may examine the teeth for pyorrhea, the mucous membrane of the mouth, pharynx, and nose for diseased conditions, the fifth cerebral nerve, and so on, nothing of importance may be found. Polypoid growths may perhaps be seen projecting from the antrum, section and microscopic examination of which may reveal the nature of the trouble, and cause the sinuses to be suspected, or leucoplakia or malignant-looking infiltration of the mucous membrane of the mouth may be seen over the hard palate, as happened in two of our cases. Roentgenographic examinations of the sinuses and teeth may reveal dental abscesses or cloudiness of the sinuses, suggesting sinusitis. In this case, the teeth may be extracted, the sinuses irrigated or the fifth nerve injected, or even sectioned, before the real nature of the trouble is discovered. Thus much valuable time is lost before signs of tumor are discovered, bringing up the question of malignant growth.

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Henry W. Waltman, reporting on malignant tumors of the nasopharynx, gives an interesting list of erroneous diagnoses and treatment in 25 cases. These included the following: Tonsillectomies, 6; extraction of teeth, 6; dissection of glands in neck, 6; drainage of nasal sinuses, 4; trifacial neuralgia (alcohol injection and nerve sections), 3; removal of nasal polyps and adenoids, 4; submucous resection of nasal septum, 2; operations on nose, 3; paracentesis of tympanic membrane, 2; abscesses incised in throat, 1; Hodgkin's disease, 1; mumps, 1; pituitary tumor, 1; dementia paralytica, 1; syphilis, 1; nasopharyngeal sarcoma, 1.

Chronic infections often precede the development of malignant growth so that we cannot foretell the outcome of an ordinary sinusitis.

The nasal polypi in two of our cases proved to be sarcomata; two cases of squamous-cell carcinoma of the mucous membrane of the mouth, hard palate and gums had carcinoma of the antrum; one had carcinoma of the antrum without mouth involvement, and one probably had sarcoma of the antrum, ethmoids and frontal on one side without mouth involvement.

The origin and manifold possibilities of extension of malignant growths being so different, it is astonishing that the only surgical procedure usual at the present time is a resection of the upper maxilla. Whoever has witnessed this operation or has gone into the literature on cancer will agree that this removal of the malignant growth is an unsatisfactory operation. The anatomy of this part of the body does not permit wide excision but forces piecemeal removal, thus making the danger of implanation great.

Barnes states that the prognosis in all of these is bad as far as surgical methods are concerned, for the following reasons:

(1) The diagnosis is difficult, especially the all-important early diagnosis. If no pus or bloody fluid, or any discharge can be obtained from an antrum in cases where a diagnosis of empyema is made, malignant disease should always be suspected. Malignant disease of the ethmoids gives rise early to nasal obstruction and epistaxis, but in cases of involvement of the other sinuses these symptoms and exophthalmos usually occur rather late.

(2) The surgeon usually does an incomplete operation. The typical exsection of the superior maxilla does not remove the entire growth, which, when usually recognized, has extended beyond the limits of operability.

(3) The surgeon is obliged to remove the tumor mass in pieces and cannot avoid implanting cells or even small pieces in the surrounding tissue. He cannot cut through tissue that is not involved in the disease.

(4) It is difficult to watch the field of operation weeks and months afterward.

Other authors come to similar conclusions. But in spite of this knowledge, the typical resection of the upper jaw is, as a rule, the operation selected. The mortality is high. Formerly 20 to 30 per cent succumbed from the operation. In the best clinics today the operative mortality is 12 to 13 per cent; and in the hands of the less skillful and experienced, the mortality must be very much higher. The operation is disfiguring in the extreme, and cannot give even a moderate hope of cure. Improved methods of treatment are therefore sought by the best surgeons.

Barnes recommends excision of a part of the cheek, so that the field of operation is left open for easy inspection and control and for convenience of operation in case of recurrence. He also inserts 35–40 mc. of radium in the sinuses during convalescence. William Clark claims marked success from electrocoagulation, which controls bleeding and does not implant the cells of the growth in the wound. New takes advantage of the soldering iron at a dull red, slow heat and eradicates the tumor by cooking it for 30–45 minutes. He claims that in addition to the control of bleeding, and the impossibility of implantation of the growth, the slow heat of the iron penetrates far beyond the point of application and destroys the tumor at points where no surgical method can reach. He also implants 100–200 mgm. of radium in the antrum at operation.

But with all these methods, surgeons are now looking to the radiologist for help.

The radiologist is called upon in these cases, more as a technician, to give treatment and assume the responsibility for the outcome. The time has come when we, as radiologists, as well educated and as experienced as the surgeon, must insist on being consultants in equal standing before any treatment is outlined.

We agree with New of the Mayo Clinic, who treated only 18 of his 33 cases of malignant disease of the antra. He says it is very important to select the cases for treatment, and not to subject them all to treatment whether or not they are in a hopeless stage. Nearly all writers who are surgeons agree that radiation is at least a valuable treatment for malignant disease of the sinuses. Beck of Chicago, however, believes that better results were obtained in these cases before the roentgen ray or radium became fashionable, but he also says that experimentation with radiation therapy should go on. The technique of application of the roentgen ray and radium, however, is very important and should always be reported.

One of the best reports is by Portmann and LaChapele. They report 84 cases of malignant growth of the oto-rhino-laryngological field which were subjected to roentgen-ray treatment and to different operations. They give a very concrete and critical review. They insist upon the cooperation of a thoroughly trained roentgenologist who has had good training in medicine and physics, and a competent pathologist who is capable of judging of the action of irradiation, with a surgeon who is broad-minded enough to refer each case for the best known treatment. They demand careful microscopic examination of each tumor, keeping closed tumors away from infection by exact suture after excision, and avoiding propagation of the growth through excision for histological examination, by means of quick reports and immediate irradiation. They come to the following conclusions: In malignant tumors of this region, of connective tissue origin, surgery, which has always been mutilating, should not precede treatment by irradiation, since the results of this latter treatment have been excellent; epithelial tumors should be subjected to surgical treatment if they are operable at all; for the tumors of connective tissue origin in the sinuses, roentgen-ray treatment is the treatment of choice, for the epithelial growths, surgery and roentgen therapy are most reliable; inoperable tumors should be subjected to irradiation, for experiment at least; postoperative treatment should never be neglected.

The following briefly reported cases illustrate some fairly successful and some unsuccessful results by irradiation and electrocoagulation:

Case 1. Miss J., aged forty-one, was referred by Dr. Montfort October 11, 1921, She had been treated for polyps of the nose. Ten days before seeing the writer a tumor of the left middle turbinate bone was removed. Microscopic examination showed it to be a perithelial sarcoma. Roentgenograms were made of the sinuses; these showed an increased density of the left antrum; 25 mgm. of radium in 1 mm. of brass and rubber was applied to the tumor area in the nose for 8 hours. Three days later, under ether anesthesia, the antrum was opened and electrocoagulated. The antrum was found occupied by a tumor mass growing from the walls; 50 mgm. of radium in ½ mm. of brass and 2 mm. of rubber was inserted into the antrum and left for 21½ hours. Roentgen-ray treatment was also given to each side of the face and neck as follows: 9 in. gap, 5 ma., 6 mm. of glass and sole leather, 9 in. distance for 20 minutes. On April 8, 1922, roentgen examination of the sinuses disclosed decided clouding of the ethmoids and antrum, and opacity of the nares on the left side. It also showed bone destruction about the lower border of the left orbit. There was apparently considerable dead bone in and about the antrum, probably due to the electrocoagulation. On May 22, 1922, the patient was beginning to develop double vision. There were also signs of recurrence of the malignant growth. Roentgenograms made in June showed increased density about the ethmoids and frontal sinuses on the left side. On February 10, 1923, sixteen months after her first operation, the patient died with signs of cerebral involvement. No autopsy was performed.

In this case we feel that it was a mistake to operate and then to apply the irradiation several days later, although whether or not the outcome would have been any different had irradiation alone been used, no one can say.

Case ii. Mrs. C., aged sixty-three, was referred to me December 12, 1921, by Dr. Sawyer and Dr. Hanke of Hillsdale, Michigan, suffering from an obstruction in the left side of the nose, which was first noted in July, 1921. She thought her trouble was catarrh and did not pay much attention to it. When first seen by the writer her nose was greatly swollen on the left side, the nasal cavity on this side being almost completely closed. The swelling extended up to the forehead, and the left eye bulged slightly. Roentgenographic examination of the sinuses showed marked cloudiness of the left antrum and ethmoids. The antrum appeared to be filled with a growth which extended into the nasal cavity. The lower border of the orbit appeared to be eroded. We made a diagnosis of tumor of the left antrum, probably malignant in character. The Wassermann reaction was negative. Twenty-five mgm. of radium filtered through brass and rubber was applied within the nasal cavity on the left side for 12 hours. Then the roentgen ray was given as follows: Distance 18 in., 5 ma., 0.5 mm. of copper filter with sole leather, for a period of 2 hours to each side of the face and neck. Within a week the swelling was almost gone. We now made a diagnosis of lymphosarcoma but no section was taken to prove this diagnosis. Roentgenograms showed but little clouding of the left antrum. On January 30, 1922, the nose was clear and roentgen examination of the sinuses showed but little clouding of the antrum and ethmoids. On May 2, 1922, a second application of radium was made. Deep roentgen therapy was also applied, using the 200,000 volt machine (4 ma., 50 cm. distance, 1 mm. of copper plus 1 mm. of aluminum, 90 min.) to each side of the face and forehead. Roentgenograms after these treatments showed the sinuses clear. The patient seemed to be perfectly well for several months. A year later, however, we learned through her physician that she had what appeared to be a metastasis in the pleura, since a quantity of bloody fluid had been taken from this region. She died in June, 1923.

Case iii. Mr. B., aged fifty-seven, was referred by Dr. Agar of Chatham, Ontario. He had been suffering from polypi involving the left nasal cavity. A section of polyp was removed and sent to the pathological laboratory of the Western University at London. The growth was reported as sarcoma undergoing myxomatous degeneration. At the time of our examination we found a soft tumor in the left nostril apparently extending from the antrum into the nasopharynx. The left antrum under roentgen examination was very dense. Fifty mgm. of radium in brass and rubber was inserted into the nasal cavity for 18 hours. Three days later the antrum was opened by Dr. Charles Oakman and found occupied by a soft tumor mass. The sinus wall in the maxillary bone also appeared to be involved. A section of this bone was sent to the laboratory and was reported as osteoma, probably not malignant. Fifty mgm. of radium was inserted into the cavity and left for 25 hours, with lead protection for the mouth. In addition to this, three series of roentgen treatments were given with the 9 in. machine with technique similar to that used in Case i. The patient developed a rather severe radium burn about the margins of the opening into the sinus resulting a few weeks later in some necrosis of the bone. The patient however recovered entirely so far as the growth was concerned, and at last report was still well.

Case iv. Mr. Y., a tailor, aged thirty-eight, was referred to the writer by Dr. Don Graham, May 7, 1921, suffering from a growth involving almost the entire mucous membrane of the upper part of the mouth, worse on the left side, and involving the upper lip. Roentgen examination showed marked cloudiness of the antrum. Microscopic examination showed squamous-cell carcinoma of a slow growing type. By means of radium plaques containing 10 to 50 mgm. of radium with very little filtering, applied two or three times, and also by means of roentgenotherapy with about 120,000 volts to the face and neck, we were able to cause the disappearance of the greater part of the growth in about two months. Later, in August, 1921, electrocoagulation of both sinuses was done. Radium was then inserted into the antra, and a second electrocoagulation was given about three weeks later, when some return of polypoid growths was noticed in both antra. This patient has made a complete recovery so far as we are able to tell at the present time, although there is considerable difficulty of speech because of the destruction of so large a part of the roof of the mouth by electrocoagulation.

From the beginning this appeared to be a hopeless case because of so extensive an involvement of the mouth and sinuses in a comparatively young man.

Case v. Mr. A., aged fifty-seven, was referred by Dr. Charles Oakman on November 7, 1919. The patient had a growth in the mucous membrane of the left upper maxilla and adjoining cheek, the region where he said he had usually carried his quid of tobacco. There were no enlarged glands. Microscopic examination showed squamous-cell carcinoma. The patient was treated with radium before and after opening the antrum, the dosage being much the same as that used in Case 1. He was also given three series of roentgen-ray treatments to the face and neck, with the 120,000 volt technique. No electrocoagulation was done. The patient suffered severe infra-orbital neuralgia for two months after the treatment, presumably from injury to the nerve from radium, finally necessitating section. This patient has remained well, so far as I know, up to the present time.

Case vi. Mr. M., aged seventy-six, suffering from a squamous-cell carcinoma of the right antrum and cheek was operated upon, the antrum being opened and a part of the growth removed. He was referred to the writer for treatment soon after, but immediately developed metastases in the neck, and in spite of radium and the roentgen ray grew continuously worse, and died about six months later. We believe the operation in this case destroyed the last chance the patient had.

I admit frankly that I cannot give a hopeful report on the treatment of malignant disease of the sinuses by irradiation, nor are satisfactory reports of such treatment to be found in the literature.We are groping in the dark; today we have one treatment, tomorrow, another, with no standard to follow. With our present knowledge of radium, deep roentgen therapy and electrocoagulation, I feel that we might standardize a method which would give promise of good results. I would suggest the following:

(1) In cases which present the definite diagnosis of sarcoma, no piece of the growth should be removed for microscopic examination, but if deemed advisable it should be removed with the assistance of electrocoagulation, followed immediately by proper deep therapy, giving as nearly homogeneous irradiation as possible.

(2) In all other cases, after painstaking attempt to make a clinical diagnosis by other methods, a section can be taken for microscopic examination if the wound is closed by electrocoagulation, followed immediately by careful irradiation. Operation by electrocoagulation should follow soon after, if it is possible to use this method in the region concerned.

(3) Recurrences should also be electrocoagulated and probably treated with radium.

(4) Cases with adenopathy or metastases are probably hopeless, and should be accepted only with the distinct understanding that such treatment is probably only palliative.

(5) Devitalization of bone must be expected in these cases where electrocoagulation is used. This may also follow heavy radiation with either radium or the roentgen ray. This bone can be easily removed a few weeks or months later.

DEEP ROENTGEN AND RADIUM THERAPY IN CARCINOMA OF THE TONSIL*

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A CAREFUL study of the literature on carcinoma of the tonsil leads one to believe that the surgical treatment of this disease is far from satisfactory. The possibility of the complete removal of the diseased tissue in the tonsil by excision is remote, and if this is not done, the operation tends to spread rather than inhibit the process. For this reason, it is rare nowadays to find a surgeon who advocates surgery in the treatment of the original lesion, radium being almost universally recommended for this purpose. A. E. Hayward Pinch states that the diseased tonsil should be removed wherever practicable, the associated cervical glands thoroughly removed and the sites of operation radiated for prophylaxis. Most surgeons, however, in recent literature advise the treatment of the tonsil with radium, and complete removal of the cervical glands by operation. Quick,[1] in a comprehensive article on this subject, sums up the treatment very carefully. In brief, he treats the primary lesion by radium entirely, and the metastases by a combination of surgery and roentgenotherapy. However, where surgery is employed, he first radiates the neck thoroughly before operation and then buries radium in the wound after the glands are removed. In some instances, he buries radium in the enlarged nodes instead of attempting their removal.

My own experience with surgery followed by radiation has not been very satisfactory. It is true that the number of cases of cancer of the tonsil which I have so treated is small, but I have seen, altogether, a large number of cases of cancer in various parts of the mouth and throat in which metastatic cervical glands have been removed by dissection and the result has been so uniformly disastrous that I would hesitate to recommend such treatment again. In my experience, recurrence has been almost invariable, the recurrence being entirely unaffected by further radiation. The final results have not been altered by burying radium in the wound at the time of operation. I have also been unsuccessful in causing the complete disappearance of metastatic malignancy in the neck by burying radium in the masses.

Referring specifically to carcinoma of the tonsil, I had a mortality of 100 per cent in these cases, no matter how treated, until I began using deep therapy. Since using deep therapy in conjunction with radium, I have 2 cases that are apparently cured, although both had metastatic masses as large as a fist when first seen.

The first great improvement in the treatment of malignancy of the tonsil, of course, came with the advent of radium. Before that time we (Dr. Johnston and myself) had treated several cases by the application of roentgen rays, both externally and through a lead glass speculum into the mouth. Some of these cases had been previously treated surgically, either by excision, or the use of the cautery, and some had not. In any event, the result was the same—they all died. Our first experience with radium was likewise disappointing. In the light of subsequent experience, this was evidently due to the fact that we had no suitable appliance to hold the radium in contact with the lesion long enough to destroy it. We then adopted as an applicator, the ordinary tonsil clamp used by surgeons to check hemorrhage and were able to hold 50 mgm. of radium against the tonsil for fifteen hours. As a result the primary lesion entirely disappeared, but the patient died of metastasis. After this, we procured radium in needles and have since treated 6 cases by introducing the radium into the tissues. In 5 of these cases, the primary lesion healed completely; the sixth is still under observation. This last case is not doing very well, due, I believe, to the fact that the lesion extends down into the sulcus between the tonsil and the tongue and possibly involves the tongue.

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[1] QUICK, D. A. Treatment of Malignant Neoplasms of Tonsils. *J. Radiol.*, 1922, iii, 173–178.

* Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 24–26, 1924.

It would seem that fairly satisfactory results may be expected from this method in so far as the primary lesion is concerned. If radium element is used instead of radium emanation, care must be taken not to overdose, or extensive sloughing will result which will be disastrous to the success of the treatment. I believe nine hours is the maximum length of time that 10 mgm. needles should be left buried in the tonsil. I have had no personal experience with radium emanation, but it should be preferable if it is available. However, it is not indispensable and radium needles are satisfactory if they are used carefully.

The treatment of the metastatic glands in the neck presents more difficulties than that of the primary lesion itself. I have had experience with the following methods:

(1) Surgical operation followed by roentgen-ray treatment.

(2) Surgical operation with insertion of radium into the wound at time of operation.

(3) Radium applied externally without operation.

(4) The roentgen ray applied externally without operation.

Of these methods, the only one which has resulted in complete disappearance of the growth without recurrence is the high voltage roentgen-ray treatment. It is true that we have so treated only 2 cases and these have been symptom-free only ten months. However, this is the first time we have been able to cause complete disappearance of large cervical metastases at all in such cases and we are hopeful that the cure will be permanent.

In the cases which have been operated upon and the glands removed, we have invariably had recurrences which were either only slightly reduced in size for a time by radiation and then took on new growth which could not be checked, or else they were entirely unaffected by radiation from the first. In the 1 case where we buried radium in the wound after the removal of an enlarged gland, the result was a large carcinomatous ulcer where a closed lesion existed before and the fatal result was hastened instead of retarded.

We had not been able to cause complete involution of the cervical metastases by the ordinary roentgen-ray treatment in use before the adoption of the high voltage method, but since then we have produced complete disappearance of masses in the neck as large as a fist in 2 cases, the primary lesion responding to the use of radium needles. These cases have been free from all visible manifestations of disease for nearly a year. As a result of this experience, I believe the following technique offers the best chance at this time for recovery from carcinoma of the tonsil.

When first seen, the cervical region on the affected side should be treated by the high voltage method, a dose being given that will produce a well-defined erythema. The exact factors used will vary with different installations, but the point is that a definite erythema dose should be given over the whole affected side before anything else is done. This has a two-fold purpose—it attempts to destroy any malignant tissue in that region and it chokes up the lymphatics and lessens the likelihood of spreading the disease when the primary lesion is treated. The factors I use on my deep therapy machine for this purpose are 20 in. skin focus distance, 200 kv., 4.5 ma., 0.5 mm. Cu. and 1 mm. Al. filters, area 4 in. sq., time 90 min. I believe deep therapy is better than radium for this purpose because it gives a more homogeneous radiation over the entire area which may be affected. After about three days, the primary lesion should be treated by introducing radium needles or emanation tubes into and around the lesion. This may be done with either local or general anesthetic, depending on the skill of the operator. If the radiologist does it himself he had better use a general anesthetic. If 10 mgm. needles are used, which is what I have, they should be placed about 1 cm. apart and left from seven to nine hours. If left too long, the resulting slough will not heal and the treatment will be unsuccessful. It requires about six weeks for the primary lesion to heal, and during this time the patient will suffer considerably from pain. Narcotics may be necessary from time to time and a mild antiseptic mouth wash should be used. At the end of about six weeks, the deep therapy treatment should be repeated whether there are any visible signs of disease or not; and I believe a third and fourth treatment at intervals of two months is a wise precaution.

CASE I. February 1, 1911, Mr. R. S. was referred by Dr. O. C. Gaub for roentgen-ray treatment. This patient had had a tonsillectomy a short time before, but following operation the right tonsil had enlarged again and there was a definite new growth protruding from the region of the tonsil. Further operation was refused by Dr. Gaub. We treated this patient with the technique then in use, consisting of an induction coil operated with a mercury interrupter, the output being about 1 ma. The tube used was made of lead glass with a small flint glass opening over which a lead glass speculum was placed. The rays were directed into the mouth through this lead glass speculum, no filter at all being used. The length of treatments was 10 min. and the patient was treated every two or three days for seventeen treatments. There was, of course, no effect on the growth. To mention such treatment as this nowadays is ridiculous and I only record it here to indicate the development of radiation treatment in malignancy of the tonsil. Such treatment, of course, was absolutely useless, but it was the beginning of our efforts in roentgenotherapy of this condition and our present methods have developed from this beginning.

CASE II. May 24, 1915, Mr. J. H. was referred to me by Dr. Shillito for roentgen-ray treatment of carcinoma involving the right tonsil and extending down to the base of the tongue. Dr. Shillito had destroyed this lesion as far as possible with actual cautery before referring the patient. There was a hard mass in the right side of the neck when the patient was first seen. There was an ulceration in the region of the tonsil left by the cautery operation. Coolidge tubes had come into use by this time and we treated this patient with transformer and Coolidge tube. A speculum was constructed of lead which was placed in his mouth and directed so as to expose the diseased tissue. The distance from the target of the tube to the lesion was 12 in., no filter was used and the patient was given 6 ma. for 10 min. with a probable back-up of about 7 in. The patient was given eleven such treatments between May 24, 1915, and August 6, 1915. At the same time, four treatments were given over the glands of the neck, using 3 mm. Al. filter. There was some improvement in this case for a time, but later the condition gradually became worse, the patient ceased treatment and eventually died.

CASE III. December 18, 1917, Mr. W. T. H. presented himself for treatment of a large carcinoma in the left side of the mouth. This lesion had apparently involved the tonsil by extension, as the patient believed that the lesion had started just back of the last molar tooth in the left lower jaw. He had had radium treatment previously without any improvement of the condition. We treated him with 50 mgm. of radium applied against the lesion, the radium being filtered by a silver capsule, 1 mm. brass capsule and 1 mm. of rubber. In the absence of any apparatus especially designed to hold radium in this location, we fastened the radium on a wooden tongue depressor and had the patient hold it against the lesion. Four different areas were treated on succeeding days, each treatment consisting of 50 mgm. of radium held in place for one hour. Following this, he had four roentgen-ray treatments applied to the left side of his neck and three applied under his chin. These were given at intervals of two weeks and the dose consisted of 5 ma. with about a 7 in. spark-gap, 3 mm. Al. filter at a distance of 10 in., the exposure being 10 min. This man became gradually worse and eventually died about four months after he was first seen. This case is a good illustration of insufficient treatment. In the light of our present experience, we know that both the radium treatment and the roentgen-ray treatment given to this patient were not nearly enough.

CASE IV. October 8, 1920, Mr. H. V., aged sixty-seven, was referred by Dr. F. A. Rhodes for treatment of advanced carcinoma of the right tonsil with extensive metastases. His trouble was of three months' duration; it came on with swelling of the neck and difficulty in swallowing. At this time, there was a large ulceration of the right tonsil which extended back into the pharynx and he had an enormous enlargement of the glands in both sides of his neck. The case appeared to be unquestionably hopeless. On October 15, 1920, 50 mgm. of radium was applied to his tonsil by means of a tonsil clamp, used by laryngologists to check hemorrhage following tonsillectomy. The radium was placed in two brass capsules, 25 mgm. in each, and fastened onto the tonsil clamp. This was placed in contact with the lesion, the clamp tightened and left in place for fifteen hours. It was, of course, necessary to keep the patient under the influence of a narcotic during this time. Following this treatment, the lesion in his mouth gradually healed. In the meantime, roentgen-ray treatment was applied over both sides of his neck and under his chin with the following technique: 9.5 in. back-up, 5 mm. Al. filter, 5 ma., 10 in. distance, 10 min. each treatment. These treatments were repeated every two weeks over each area. The patient died on January 5, 1921. At the time of his death the primary lesion in his throat was entirely healed; and while there was some reduction in the size of the glands in his neck, evidently the metastases had extended and from his symptoms he died of metastasis to his mediastinum. This is the first case where we were able to destroy the primary lesion, but the result was the same—the patient finally died of metastasis.

Case v. January 20, 1922, Mr. R. D. F. was referred by Dr. C. M. Straessley for treatment of a large carcinoma just back of the third molar tooth in the right upper jaw, extending into the tonsil and up into the soft palate. There was an enlarged gland about the size of a pigeon's egg to the right side of his neck. On January 21, 1922, four radium needles were imbedded in and around the lesion. The patient was not sufficiently narcotized following the introduction of the radium and he coughed a great deal. As a result of this, one of the needles was coughed out four hours after introduction and one six hours after introduction. The other two were removed at the end of nine hours. Following this treatment, there was considerable sloughing, but the lesion finally healed and remained entirely healed up to the time of his death. On January 23, 1922, roentgen-ray treatment was begun over the glands in his neck. The technique used at that time was: 9.5 in. back-up, 6 mm. Al. 5 ma., 10 in. distance. The first treatment was 10 min. long; subsequent treatments were seven or eight minutes. The roentgen-ray treatments over his glands were pushed to the limit, oftentimes not more than a week elapsing between treatments, and when severe reaction was reached, treatment was discontinued for a while to allow the skin to recover. This treatment was carried out from January 23 to April 25. On May 17, the glands still being uninfluenced, we applied 50 mgm. of radium over the gland at 0.75 in. distance and left it in position for fifteen hours. Two months later, on July 16, 1922, this treatment was repeated, the same quantity and the same distance, and left in place for eighteen hours. This gland was still unaffected. The roentgen-ray treatment was resumed in August, 1922, and continued for five treatments. On November 23, 1922, the gland still being unaffected and increasing in size, a surgeon was called in. He removed the gland and we buried radium in the wound and left it for twelve hours, 50 mgm. being used, divided into 2 capsules of 25 mgm. each, filtered with 1 mm. brass filter and covered with rubber. The result of this treatment was a large malignant ulceration which never healed. The patient finally died about two months after the last treatment. This case illustrates the extreme resistance of metastatic lesions to radiation. This case failed entirely to respond to ordinary roentgen-ray treatment, radium treatment applied externally, or radium buried in the wound after excision.

Case vi. March 12, 1923, Mr. D. W. McG. was referred by Dr. B. L. Calhoun, Verona, Pa., for radiation treatment of a recurrent carcinoma involving the tissues just in front of the left tonsil and extending into the tonsil. There were several enlarged glands in the left side of the neck. The patient had had a cautery operation five months before for carcinoma in the region of the present recurrence. The disease returned very quickly after operation and continued to spread. In this case, we were able to make a contact application of radium by fastening the radium on a piece of lead and bending the lead so as to fit into the mouth and come out around the cheek. All the teeth were out in this case. Fifty mgm. of radium was applied through 1 mm. of brass and 2 mm. of rubber, and left in place for twelve hours. Following this treatment, the lesion in the mouth entirely healed up. The glands in the neck were treated by external application of radium on March 28, 1923, 50 mgm. being applied at a distance of 0.75 in. and left in position for fifteen and one-half hours. This treatment was repeated on April 26, 1923, the length of application at that time being fourteen hours. The enlarged glands were not influenced by this treatment. On May 24, 1923, the patient was given a treatment with the high voltage roentgen-ray machine, the technique used being 4.5 ma., 200,000 volts, filtered through 0.5 mm. Cu. and 1 mm. Al. distance 20 in., the exposure being 75 min. This was also ineffectual and the patient finally died about two months later. This case is a good illustration of many similar experiences we have had in metastatic malignancy in the neck. In practically all of the cases where operation has been performed on a primary lesion in the mouth, or on the metastatic glands in the neck, we have been unable to influence the glands subsequently by radiation treatment.

Case vii. April 3, 1923, Mr. J. J. O'C. was referred by Dr. S. F. Hogsett for treatment of a large carcinoma of the left tonsil. The exact duration of this lesion was not known, but he had had a very large lump in his neck since last November, a period of six months, and the primary lesion must have ante-dated this lump by an appreciable period. This was a very advanced case of carcinoma of the tonsil and the metastases in the neck were as large as a fist. We felt that the case was hopeless but agreed to do what we could. He was given a high voltage roentgen-ray treatment on the first day that he was seen, the technique consisting of 4.5 ma., 200,000 volts, 0.5 mm. Cu. and 1 mm. Al. filter, distance of 20 in. and an exposure of 80 min. Three days later, radium needles were inserted into the tonsil and even at that early date, the gland in his neck was only about half as large as it was before the roentgen-ray treatment. Four needles were placed in the tonsil and left in position for nine hours. Following this treatment, the primary lesion promptly disappeared and when the patient was next seen about six weeks later, the gland in his neck was almost gone. We repeated the deep therapy treatment on May 19, 1923, and again on July 14, 1923. At the time of his last treatment there was no enlargement of his neck at all, the treatment simply being given for prophylaxis. This man is entirely free from any evidence of disease at this date.

Case viii. April 10, 1923, Mr. F. R. W. was referred by Dr. C. L. Harsha of Canonsburg, Pa., for treatment of a small carcinoma in the right tonsil. This patient's trouble was apparently of only about 5 weeks' duration, as it was at that time he noticed a lump in the right side of his neck. His throat was not examined at that time. The lump continued to increase in size and he came home from the Pacific Coast to consult his home doctor who discovered an ulceration in the tonsil. This was touched up with silver, but the treatment was ineffective and within the last two weeks the lesion has grown with great rapidity until at this time the whole tonsil is covered with a large fungating ulcer. In the meantime, the lump in his neck has enlarged until it is now as large as a fist. This man was given a high voltage roentgen-ray treatment on the first day he was seen, the technique consisting of 4.5 ma., 200,000 volts, with 0.5 mm. Cu. and 1 mm. Al. filter, distance, 20 in., exposure, 75 min. Four days later, four radium needles were introduced into his tonsil and these were left in place for seven hours. He was next seen on May 26, 1923, or about six weeks later, and at that time the glands in his neck had entirely disappeared and the lesion in his throat was also entirely healed. We gave him a second high voltage treatment as a prophylactic measure and did not see him again until August 30, 1923, when he re-appeared with another similar gland just above the clavicle. This gland was outside the area that had been treated previously. We repeated the deep therapy treatment, giving him an exposure of 85 minutes at that time. This treatment caused the complete disappearance of this gland. On October 26, 1923, he was entirely well. We gave him another prophylactic treatment of deep therapy at this time. This patient has remained well to this date.

Case ix. April 21, 1923, Mr. G. U. was referred by Dr. M. R. Hoon for treatment of carcinoma of the left tonsil. This man came to the hospital about two weeks previous to this time, with a mass of enlarged glands in the left side of his neck. These were thought to be tuberculous and were removed. One of them was sent to the Mayo Clinic and was reported back as being carcinomatous. In the two weeks that had intervened, the mass in the neck had recurred and was about the size of a fist. His throat was then examined and a small ulceration found on the left tonsil. Three radium needles were introduced into this tonsil on April 23, 1923, and left in position for seven hours. This was followed by deep therapy treatment over the glands in his neck. There was no improvement in his neck following this treatment and on May 25, a second treatment with the high voltage machine was given, the same technique being used as already described in previous cases. The primary lesion in the tonsil promptly healed up and remained healed, but there was very slight improvement in the glands in his neck. This patient dropped out of sight and we were told about two months later by his family doctor that he was very much worse and apparently in a hopeless condition from metastases.

Case x. We have another case of carcinoma of the tonsil still under treatment, first seen October 23, 1923, in which there are no demonstrable metastases in the neck. This case has been given deep therapy treatment over the neck as a prophylactic measure and has had radium needles inserted into the tonsil. However, the improvement in the primary lesion is not satisfactory in this case and we are not sure what the outcome will be. In this case, the lesion extends down onto the base of the tongue. I believe this probably accounts for the rather unsatisfactory response to the treatment.

A summary of the above case reports represents our experience in the treatment of carcinoma of the tonsil. We first attempted to treat such cases by the use of the roentgen-ray alone, directing the ray into the mouth through a speculum and treating the glands externally by roentgen-ray treatment. This treatment was absolutely ineffectual.

The next method was the surface application of radium against the primary lesion and the treatment of the neck with the roentgen-ray from without. The treatment of the primary lesion in this way is effective, provided the radium can be kept in contact with the lesion for a long enough time.

The next step was the use of radium needles instead of radium applied to the surface, which increases the probability of the complete destruction of the lesion.

The metastases in the neck have been treated by:

(1) Ordinary roentgen-ray methods either alone, or following surgical removal.

(2) Radium applied externally and also in the wound following surgical removal.

(3) Deep therapy both before and after surgical removal.

Our best results have been obtained with deep therapy over the glands of the neck before anything else is done, and this followed by use of radium on the primary lesion.

DISCUSSION[1]

Dr. Douglas Quick, New York City. I did not hear all of Dr. Stevens' paper, but two or three things struck me as I heard the latter part of it. The first is that I think we ought to distinguish sharply the types of diseases we are dealing with when outlining treatment here; for instance, those that produce symptoms first by blocking up the nasal passages posteriorly are usually those arising from the lymphoid tissue in the postnasal space. These are very bulky, rapidly growing tumors, which metastasize early. They may be only a local manifestation of a disease which is quite widely disseminated. They are very cellular and respond readily to radiation. Whether radium is to be introduced directly, or radium and roentgen ray used externally, can only be determined at the time. Further forward, the tumors that block up the nasal passages range from the ordinary fibromas to the very acellular resistant fibrosarcomas. There I agree with Dr. Stevens that less surgery and more radiation, both by introduction of emanation or radium needles into the mass, plus external radiation, offers the best chance. They are very dense, respond slowly, and a good deal of encouragement needs to be given the patient through that period. Then the real groups under discussion are those primary in the antrum. We hear much about sarcoma of the antrum. I think it is a rather rare disease. We see it in young people occasionally but the common growth in the antrum is squamous-cell carcinoma; the plan of treatment depends upon the condition at the time the patient presents himself. There are those that invade the inner wall of the antrum, blocking up the nose first. There are those that invade the orbital plate and the first evidence is an elevated, bulging eye. There are others that perforate a tooth socket after a tooth has been extracted, or that invade the anterior wall, producing a mass in the mouth. I think the agents at our disposal are radium used inside the mouth, either needles or emanation, and heavy external radiation. Most of our cases have been treated with heavy radium packs; more recently the high voltage roentgen ray offers much, or the two may be combined. There is another important factor after we have started our radiation in the group of cases; that is the matter of infection. The infection alone which gets in through these ulcerated surfaces has a great deal to do with the progress of the case and may terminate life quite apart from the disease. We must provide for drainage; whether that is done by Dr. New's method of using a soldering iron, electrocoagulation or surgical removal of the anterior wall, or wall plus the alveolus, completely removing the diseased tissue and putting radium in the wound, depends largely on the armamentarium one has at his disposal. During the past year we have added one more radical step that has helped in a certain group of these cases; that is those with the invasion of the orbital plate resulting in a bulging eye. I think we have tried to save too many eyes. I think, in those cases, if the eye is removed, one can get at the disease above and below. The result is frequently the saving of a life by the sacrifice of an eye.

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[1] This discussion has reference to the preceding paper by Dr. Stevens, as well as to the above.

From Dr. Grier's paper I am sorry to learn that he has not had better results in radiation of the neck. I think he touched squarely on the real problem there; that in the tonsil, as with most of the intra-oral cases, the neck is the real problem. We have tried various methods and our plan at present has offered us the best results. That is, heavy external radiation either with the radium pack or high voltage roentgen ray with radium in the wound. We have cases of inoperable nodes in the neck that have been carried along for three years by implantation of radium. I do not believe those cases are free from disease and we will undoubtedly have trouble with them later, but we must remember that we cannot hope to cure all cases of malignant disease. The early ones we can cure, but in the more advanced ones it is our business to give as much relief as possible.

Dr. J. D. Morgan, Philadelphia. We have had a large series of these cases, involving the accessory sinuses, in the William L. Clark Hospital, in Philadelphia. Most of them were referred to us as surgically inoperable. Our experience has been that the majority of these cases do not respond well to radiation therapy alone, and that recurrences are very apt to follow. We consider electrocoagulation to be the method of choice, followed, perhaps, by radiation therapy, either radium, or the short wavelength roentgen rays, or possibly by both.

The condition is one where the life of the patient is naturally the first consideration, but, involving the face as it does, it is of advantage to consider the cosmetic results as well. Therefore, several avenues of approach are offered. If, for instance, the hard palate is already involved, the most logical method is the destruction of the involved portion, thus establishing an opening into the antrum through which subsequent dressings, or treatments, can be made. When healing is complete a plate can be made to cover the opening in order to assist speech and to prevent food from entering the antrum. If the tissues of the face are involved, an incision may be made through the cheek and the antrum treated by this route. Or, if the bones and tissues are considerably involved, a large flap of the skin and muscles may be turned back, giving a very wide avenue of approach. The resulting scar is slight and the results very satisfactory. Again, if the eye is involved, it may be exenterated, and the antrum and ethmoids entered through the floor of the orbit. The remarks of Dr. Quick relative to the saving of the eye corroborate our own experience. It does not pay to try to save many of these eyes, the lives of the patients being too often sacrificed in the end. The great advantage, in our opinion, of the coagulation method over radium, or the roentgen ray, is that these cases when once treated by radiation, do not offer favorable opportunity for further radiation; they seem to become more resistant, whereas, with the coagulation method, the treatment can be repeated as often as is necessary should areas of recurrence appear and, in addition, one has radiation in reserve as a supplementary form of treatment. In some of these cases we use radium, in a capsule, following coagulation, if, at the operation, it has been found impossible to remove all the diseased tissue.

In the treatment of malignant tonsils, desiccation is of great value, combining with it radiation therapy with either radium or roentgen rays. We prefer to use small needles rather than emanation tubes.

EXPERIMENTAL STUDIES IN ROENTGEN-RAY EFFECTS

BY JAMES B. MURPHY, M.D.

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OUR first interest in the roentgen ray was due entirely to its effect on the lymphoid tissue, and at the time these studies were undertaken we had no idea of delving into the realm of roentgen-ray therapy. However, certain points of view were developed in the course of the work which seemed to have a bearing on the practical use of this powerful agent. The recent revival of interest in the therapeutic value of the roentgen ray, subsequent to the development of high voltage tubes and generators has stimulated us to test our ideas by direct experimentation.

Certain observations were made which brought up the question of the correctness of the commonly accepted idea that cancer cells are more sensitive to radiation than normal cells. At that time no reports of experiments could be found in the literature which adequately proved or disproved this fundamental point. Either the dose was so large that it could not be compared with that used in the treatment of man, or the effect of the roentgen ray on the animal was not taken into consideration. For our own satisfaction we devised a simple experiment which would more or less follow the method of treatment in common use, but with a dose three to four times larger than that used for treatment. The details of this experiment need not be gone into here. Suffice it to say that a transplanted tumor of the mouse, given a massive exposure *in vitro* every five weeks for over a year and a half, showed only a transitory interference with the growth energy of the cancer. At the end of the experiment the irradiated tumor was growing just as vigorously as the control untreated tumor carried in a parallel series of mice. More recently the carefully planned experiments reported from the George Crocker Special Research Fund Laboratory of Columbia University, show beyond a doubt that the sensitiveness of cancer cells to the roentgen ray is far less than generally supposed, the lethal dose being four to five times the erythema dose.

If it is true that cancer cells are not killed by the direct action of the rays, how are we to account for their beneficial effect in certain types of cancer? The following experiments are an attempt to analyse the factors involved in the cure, more particularly of skin cancer. These are reported briefly here in order to give an idea of the data on which our conclusions are based.[1]

Mice were given an erythema dose of roentgen ray over a small area in the left groin and after the treatment a small bit of a highly malignant cancer was inoculated intracutaneously into this area. For a control a graft of the same cancer was inoculated into the skin of the right groin, which had been protected from the rays. The result was a complete growth inhibition of the tumor in the irradiated area of practically all of the animals, whereas in the normal skin the tumor grew with its usual vigor.[1]

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[1] A more detailed account may be found in the following articles: MURPHY, JAMES B., HUSSEY, RAYMOND G., NAKAHARA, WARO, and STURM, ERNEST. Studies on *x*-ray effects. VI. Effect of the cellular reaction induced by *x*-rays on cancer grafts. *J. Exper. M.*, 1921, xxxiii, 299.

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NAKAHARA, WARO. Studies on *x*-ray effects. XIII. Histological study of the fate of cancer grafts inoculated into an *x*-rayed area. *J. Exper. M.*, 1923, xxxviii, 309–314.

MURPHY, JAMES B., MAISIN, JOSEPH, and STURM, ERNEST. Local resistance to spontaneous mouse cancer induced by *x*-rays. *J. Exper. M.*, 1923, xxxviii, 645–653.

In another series of experiments, identical with the foregoing ones, except that the cancer was inoculated under instead of into the skin, there was no difference among the tumors in the rate of growth in the treated areas and those in the normal areas. It would seem, therefore, that the treatment conferred a local immunity on the skin only, this not even extending to the underlying subcutaneous tissue.

A microscopic examination offers a possible explanation of this observation, in that the roentgen-ray treatment is followed by a marked local cellular reaction confined to the skin and completely absent from the subcutaneous tissue. This cellular reaction is of the type which we have learned to associate with resistance to cancer and therefore we are inclined to believe that the reaction induced by the roentgen ray is possibly the active agent in the destruction of cancer cells.

Another point of interest in these experiments is that the cancer cells implanted in a treated area of skin show a series of degenerative changes identical with the frequently described stages of cancer cell degeneration following direct roentgen-ray treatment and which is generally interpreted as proof of the direct action of the roentgen ray on the cells.

An obvious objection to the experiments just reported is the fact that we used a transplanted tumor, which, as is known, is not in all respects comparable to the spontaneous disease. To obviate this objection .the experiments were repeated on animals with spontaneous cancers. The primary tumors were removed at operation and then an area on the backs of the mice was exposed to an erythema dose of roentgen ray. Immediately afterward a small bit of the cancer (autograft) was replanted in the treated area and another bit on the opposite side in a normal area of skin. The result was that the cancer rarely grew in the treated area while it progressed actively in the normal skin. Forty-nine mice with spontaneous mammary cancer were utilized in this experiment.

In the foregoing experiment it may be considered that at best the treatment only prevented a "take." What would be the effect of similar treatment on an established tumor? Another group of mice with spontaneous cancers were operated on and the tumors removed. Each tumor was divided into two portions, one of which was exposed directly to a treatment dose of roentgen ray *in vitro*. Then a graft from each portion was replanted intracutaneously in the original animal. Tumors developed from both the treated and untreated grafts and there was no detectable difference in the rate of growth between the two. After these were well established, the tumors arising from the untreated portion were given a like treatment of roentgen ray *in situ*, the exposure including the surrounding skin. A week later these cancers had been completely absorbed in the majority of cases whereas the tumors resulting from graft which had been irradiated outside the body continued to grow till they killed the animals. This procedure was carried out on fifty mice with spontaneous mammary cancer.

In considering the preceding experiments the question naturally arises as to whether cancer cells are more susceptible when treated with roentgen ray *in vivo* than when treated *in vitro*. This point has been covered in still another experiment which is similar to the preceding one except that the established graft, after being treated *in situ* was removed and replanted in another location on the same animal. In other words, we removed the cancer cells from the surrounding treated tissue in order to determine the actual amount of damage inflicted by the direct action of the rays. The transferred cells grew in 78.8 per cent of the forty-seven mice constituting the experiment. It would seem, therefore, that there is no increased susceptibility of tumor cells treated with roentgen rays *in situ* and that tumors so treated, when removed from the unfavorable environment, show no effect from the treatment.

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[1] A study of the condition of the vessels in the radiated areas and a comparison of the vascular supply furnished to the grafts showed that this result did not depend on any interference with the blood supply.

SUMMARY

Autografts from spontaneous cancer of mice, when replanted in an area of skin previously exposed to an erythema dose of roentgen ray, failed to grow in the majority of instances (71.4 per cent), while similar grafts inoculated into an untreated area grew in a large proportion of animals (83.6 per cent). Autografts of spontaneous cancer, established and growing in the skin, disappeared in 76 per cent of the mice after the tumor and surrounding skin had been exposed to an erythema dose of roentgen ray, while other autografts of similar derivation which had been given a like dose of roentgen ray outside the body, and had been replaced in the same animal, grew progressively in 96 per cent of the fifty mice making up the experiment. That this result was not due to a greater susceptibility of the cancer cells treated with roentgen rays *in situ* was shown by the fact that tumors treated *in situ* and then replanted in an unrayed location on the same animal showed slight if any effect from the treatment (78.9 per cent positives in 47 mice).

There is always some hesitancy in accepting principles established by animal experimentation and there is no doubt that the course of inoculated disease may be different from what we may term natural disease. In the main experiments reported here we have dealt with the natural disease, and as far as we can determine, the spontaneous cancer of mice does not differ in an essential way from the disease as it occurs in man. Whether or not the mouse responds to roentgen-ray treatment in a manner different from man remains to be determined by the practical worker in roentgen-ray therapy. Ewing's observations from the study of human material are most suggestive that the general principle established by us for animals may hold true for man.

Unquestionably the present method of treatment is based on the idea that the roentgen ray has a more or less selective action on cancer tissue. If it is proved that this idea is incorrect and that the roentgen ray exerts its effect in man, as in mice, by creating an unsuitable environment for the survival and growth of cancer, it should be possible to put roentgen-ray therapy on a rational basis with the probability that it can be developed into a more effective form of treatment than it is at the present time.

The further elucidation of this problem and the applicability of the principles to the human disease depend for their development on the clinician and the practical roentgen-ray therapeutist.

THE ROENTGEN-RAY TREATMENT OF KELOIDS*

BY HENRY H. HAZEN, M.D.

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KELOIDS and hypertrophic scars were first treated with roentgen rays by Ullmann, Hahn, Albers-Schönberg, Taylor, Harris, Crocker, Morton, Pusey, Edwards and Allen. The earliest observers to use radium were Williams, Wickham, and Degrais.

Many dermatologists believe that there are two types of keloid—the spontaneous keloid, and the keloid that develops in a scar. The probabilities are that the former type always arises from some injury, be it ever so minute. Keloids vary much in size and in hardness, old lesions sometimes being of almost cartilaginous consistency. In color they may be red, brown, or like normal skin; frequently they are telangiectatic.

Keloids occur only in certain individuals, and it is generally recognized that negroes are particularly prone to this malady.

Any method of treatment that produces a wound is usually followed by a keloid larger than the one removed.

Irradiation is not a true prophylactic against the development of keloids, but is of distinct value if employed at the proper time. Pfahler recommends a pre-operative suberythema dose in case surgery is to be attempted, but MacKee believes this to be of no real value.

Very large keloids cannot be removed by either the roentgen ray or radium without the risk of serious sequelae. In such instances the growths should be surgically removed and irradiation employed as a prophylactic, for it is generally recognized that an early lesion can nearly always be successfully treated.

According to MacKee keloids not more than one inch in diameter will disappear in from one to four subintensive treatments. Growths more than one and one-half inch in diameter may require from eight to twelve suberythema applications over a period of a year or more. Very thick or very hard lesions may be so resistant that irradiation is unsafe. The same is true of keloidal bands scattered over large areas. In the case of small lesions the skin is usually soft and pliable, but telangiectasia is too prone to occur. It seems curious that the treatment of small basal-cell cancers is not nearly so prone to result in telangiectases as is the treatment of keloids where the area exposed is the same, and where the total amount of irradiation in the former condition is four or five times greater than the latter.

Sixteen patients, 1 male and 15 females, with a total of 35 lesions have been treated by my associate, Dr. F. J. Eichenlaub, and myself.

The following table will show the types of lesions, the average number of treatments and the end results.

TABLE I

Type of Lesions		Average number of Treatments	Result
Abdominal incision scars	2	6	cure
Thyroid scars	2	4	cure
Large diffuse band	1	12	good
Small diffuse band	3	7	1 good 2 failures
Small hard lesions	3	5	1 cure 2 failures
Very large (3 in.)	2	11	cure
Ordinary	22	6	21 cures 1 failure

In 4 instances telangiectases are known to have developed; in 15 instances no telangiectases had developed at the end of one year; and the result is unknown in 16 instances. The large keloids in all instances showed telangiectasia.

The technique employed in the case of small lesions was as follows: spark-gap, 7½ in.; milliamperage, 5; time, 1 min. and 15 sec. to 1 min. and 40 sec., focal skin distance, 9 in.; no filtration, treatments at intervals of 3 weeks. When the lesions were large from 1 to 2 mm. of aluminum were employed and the time proportionately increased. When there were lesions upon the face the greatest care was used not to produce an erythema, which probably accounts for two failures where there were small diffuse bands. One striking fact is that soft keloids will frequently gradually disappear over a period of months following two or three treatments. In all late cases advantage has been taken of this fact to develop the following technique: Two treatments are given at intervals of three or four weeks, the patient is allowed to rest for three or four months, and then two more treatments are given if necessary.

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* Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 24–26, 1924.

In one instance a prophylactic treatment was administered ten days before operation, and again ten days after operation, but proved a complete failure.

Negroes are undoubtedly much harder to treat than white patients. In our hospital work it has frequently been observed that keloids would refuse to disappear until a secondary degree dermatitis had been produced. In one small, soft keloid occurring in a Filipino eleven treatments were necessary to flatten the lesions.

CONCLUSIONS

The vast majority of keloids can be successfully treated by the roentgen ray. The chief risk is that telangiectasia may develop. Small, hard lesions, and lesions occurring upon the face are extremely difficult to handle. Large lesions should probably be excised and irradiation begun immediately after the operation. Keloids in negroes are more difficult to treat than those in white persons.

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DISCUSSION

Dr. G. E. Pfahler, Philadelphia. I have been interested in this subject. I do not believe that we can lay down any very positive rules. My plan, based upon experience, is this: If we have a large area of keloid following a large or extensive burn, we must be much more careful in the application of the rays than we are in the treatment of a small or localized keloid, and I am inclined to think that divided doses kept well under an erythema dose will give the best results; at least they have done so in my hands. I have treated some very extensive keloids following burns, with small divided doses with perfect results. No telangiectases occurred, and the softness of the skin or scar was preserved. With regard to the technique of the treatment of other less extensive lesions, I think the treatment outlined by Dr. Hazen is the correct one, except that I feel that three or four months after the first two treatments, a third should be given, and then an interval of two or three months allowed to pass before the fourth treatment is given. The theory is that the first two treatments stop the growth and then time is allowed for atrophy, after which the atrophy is continued by the third and fourth doses. I believe that if we follow that technique we can decrease the amount of radiation usually given. Now in the next type, where we have a definitely localized, thickened keloid, I am convinced that a preliminary dose of roentgen rays followed by excision and then in about ten days by another dose of rays, will give the best results. I have had the most satisfactory results in these cases because all of the scar is practically eliminated. When attempt is made to reduce a very much thickened scar entirely by radiation, there is danger of too much radiation and definite degeneration, and in addition telangiectasis may occur. In general, I think we must give more attention to this question of telangiectasis and skin atrophy in connection with our skin treatment. My experience has been different from Dr. Hazen's. In the majority of cases the telangiectases have occurred one, two, three or four years after the radiation. Yesterday I saw a patient whom I treated for hypertrichosis four years ago. There is some skin atrophy, smoothness of the skin and just a little blotching developing now, four years afterwards; there was none a year ago or six months ago. In breast cases I have repeatedly seen this develop three and four years after the radiation treatment, and we must not conclude that we are not going to have it when it does not appear in the first year. I think we must give more attention to the preservation of our normal tissues in all of our therapeutic work.

Dr. G. W. Grier, Pittsburgh. I have had an experience similar to that recounted by Dr. Hazen in the treatment of keloids. I treated a little boy with two keloids on the face following burns. He had three or four treatments, and as he was not getting any better, the parents had treatment stopped. About a year later they brought him back to have further treatment because he was practically well. In that year the keloids had almost disappeared, and when he had ceased treatment, which was perhaps two months after his first treatment, there was no appreciable difference in the size of the keloids. I believe, therefore, that time plays a big part in the healing of keloids, and I think as Dr. Hazen has said, that the treatment ought to be extended over a fairly long period. It certainly does no harm if the keloid is not growing, to extend the treatment over a year or two. In regard to telangiectasis, I have had the experience mentioned by Dr. Pfahler, that is, it occurs a long time after the treatment is stopped. I saw a patient treated in 1912 who developed telangiectasis eleven years after she was treated.

Dr. S. Stern, New York City. I have been treating these keloids for a great many years and have got away from the 4 unit treatment altogether; I find that treatment with half unit doses seems decidedly better, and I think the chances of escaping telangiectasis are a little better. I usually give a half dose at weekly intervals, and then wait a considerable time before continuing treatment. As far as the prophylactic effect of the ray in keloids is concerned, I am convinced there is a great deal to it. I remember one case distinctly in a young woman who had a small keloid about one inch long on her shoulder which was excised by a surgeon with the result that the next keloid was three inches long. She then went to another surgeon, who again excised it; the next keloid was five inches long. I happened to meet the surgeon and asked him why he did not try prophylactic treatment to avoid the appearance of this keloid. He did so with the most satisfactory results. I believe that Dr. Pfahler's observations in regard to telangiectasia are absolutely correct: They come much later than a few months after treatment; I rarely see them in less than a year or two, and I have adopted a technique within the last three or four years which I think has helped to prevent their occurrence. As soon as the roentgen treatment is finished I advise vigorous massage of the parts treated, night and morning, to be kept up indefinitely, and since the patients have been carrying out this treatment I have seen less telangiectasis.

Dr. Hazen, closing. I am very glad to note that a number of other men have had the same experiences that I have had with telangiectases frequently coming on extremely late. I think there has been too much teaching that they are practically sure to occur within the first year. Judging from my own experience I was sure this could not be true; it is also a great comfort to have Dr. Pfahler and others bear me out that they are of frequent occurrence. A number of dermatologists claim to have had extremely good results from the rays of quartz lamps in keloids, using the lamp as a rule with a filter and directly upon the skin. I have tried this in three separate cases myself and have had no results whatever. I do not believe that the lamp is going to be nearly as certain as the roentgen ray, but in view of what dermatologists of undoubted training and acumen have said, there can be no question but that it will work in certain cases, probably early cases. In regard to the treatment of telangiectasia, in cases without any atrophy, I am much inclined to feel that we can remove a large number by the use of water-cooled quartz lamps. I have had a number of cases, one or two extensive ones, involving the whole thyroid and thymus areas, in which practically every sign of redness has been obliterated; if there is any skin atrophy that already exists, that atrophy is not changed, possibly very slightly increased, and with the use of the quartz lamp there is always a slight risk of a minimum amount of pigmentation occurring at times.

ROENTGEN-RAY TREATMENT OF BONE SARCOMA*

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THE first case which I have to report is a bone tumor which it seems reasonable to classify as malignant or central sarcoma.

The series of slides show the early invasion and expansion of the tumor through the cortex. The possibility of regeneration of bone or new bone formation brought about by roentgenotherapy, which corresponded to a definite clinical improvement looked encouraging until metastases in the lung appeared, when, notwithstanding continued treatment, the metastases and the tumor in the femur increased, death occurring six months after admission to the hospital.

The second case illustrates the new bone formation or regeneration brought about by roentgenotherapy in a tumor which, from subsequent study seemed to classify the tumor as the giant cell variety.

In the first case, surgery was employed, and a pathological examination made, while in the second case there was no surgery and no pathological examination to assist in the diagnosis.

The benign tumor case made a satisfactory recovery and is apparently well today, and the result seems to conform to other cases of giant cell tumor, as reported by Codman, who finds that all giant cell tumors recover under either roentgen-ray treatment or surgery and that metastases are never found, with possibly a single exception reported by Ewing.[1]

Statistics worked out by those who have made a study of malignant sarcoma of the bone are decidedly discouraging even where surgery or a combination of surgery and roentgenotherapy are employed. Even in early amputation or removal the longest period of life seems to be about three years, the greater proportion living one year or less, according to Bloodgood. Codman states that in the registration of bone sarcoma cases there is only 1 case on record as having recovered and being in good health today, which was treated by radium and Coley's toxins, and 5 cases in which early amputation was performed. Surgery seems to be the method of choice, and thus far comparatively few cases have been reported in which roentgen-ray treatment alone was used. It would therefore seem desirable that roentgenologists be given an opportunity to treat more of these unfortunate cases. Early recognition of the condition is the great problem and this can only be accomplished by careful examination.

The treatment of benign bone cysts is not advocated, but it would be better to treat a bone cyst, if in doubt, than to neglect to treat a periosteal or central sarcoma.

Roentgen rays, then, should be applied at the earliest possible moment regardless of the pathology, provided osteomyelitis in which surgical treatment is indicated, can be excluded. The next problem is the dosage. Voltage, filter, and distance are all important. We are told that homogeneous rays are necessary and that, depending on the different types of cells, different degrees of hardness of rays should be used. For this problem we should look to those who are best fitted to prescribe a bone sarcoma dose.

While we may influence the growth of the giant cell tumor with a certain dosage, the malignant cell may not be changed to any great extent. Whatever dose may be best a definite plan of intensive treatment pushed to skin tolerance should be adopted, whether using large or small portals of entry, including also the entire drainage area in succeeding doses to and including the chest. Applying treatment to the bone growth is not sufficient; there should be a gradual overlapping of areas every few days until nearly the entire body on the affected side is covered, then a definite period should elapse before the dose is again given.

CASE I. Female, Italian, aged thirteen, was admitted to the hospital in July, 1923. Two months previous she had received a slight injury to the right thigh above the knee. On admission there was noted a slight swelling of the lower end of the femur, local heat, pain, tenderness and a temperature ranging from 99° to 101°F., not unlike the temperature of an osteomyelitis. Wassermann negative. Roentgen examination showed expansion of the cortex with a destructive area in the center. Succeeding films at intervals of two to three weeks showed the advancing expansion of the cortex and the first evidence of breaking through the cortex. At this stage of increasing temperature and pain the surgeon drained the bone area, and the pathological report of the scrapings showed giant cells of the mixed type, areas of spindle cells, giant cells of the malignant type together with multinuclear epulis giant cells. The surgeon, being at a loss as to the continuation of treatment, or amputation, asked the advice of the roentgen department. The roentgenologist in charge advised roentgen-ray treatment, which was started about four weeks after the operation. The patient had a one-hour treatment every ten days for three treatments, 180 kv., through 0.5 mm. Al. filter at a distance of 50 cm., through three portals of entry. Following the second treatment, it was possible to see some change in the margins of the tumor as noted on the films. These changes were similar to those seen in the treatment of the giant cell tumor; namely, bone production or regeneration. In other words, it seemed as if the osteoclasts of the periosteum were making an effort to produce bone. After the third treatment, although the chest had been carefully watched, evidence of metastases was discovered in small circumscribed areas throughout the lung. Treatment was then given to the chest, each treatment being accompanied by extreme radiation sickness. With the appearance of metastases in the lungs the tumor of the thigh became larger, bone destruction advanced and the new bone shell increased.

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[1] Arch. Surg., September, 1923, vii, 280–296.

* Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 24–26, 1924.

Case ii. Female, white, aged twenty-nine, married, gave a history of slight injury and the gradual enlargement of the knee. Moderate pain; no fever at this stage of the tumor growth. The patient had consulted a physician who made his own roentgen-ray examination and advised amputation of the leg above the knee. She sought my advice as to roentgen-ray treatments, refusing to consider amputation. She was given treatment every ten days to various areas; that is, anterior, posterior and lateral, and also areas including the entire thigh and groin. At no time was the chest given treatment but repeated and frequent examinations were made to ascertain the presence of metastases. The swelling of the leg and knee continued with the increase in bone destruction. The leg was greatly swollen and edematous, and there was enlargement of the glands of the groin. It seemed doubtful that we were dealing with a giant cell tumor, but rather that we were dealing with a central sarcoma of the malignant type. The patient looked badly and it seemed as if metastases had occurred. However when she again reported for treatment, it was evident that a marked clinical improvement had taken place and there was sufficient evidence of bone production to confirm this. Treatment was then continued at intervals of six weeks to three months. It was soon possible to discontinue the use of the plaster of paris casts which the patient had been using as a protection from fracture of the tibia. Twenty months after the first treatment the patient was well and driving her own car. It was the general opinion of those who had seen the case that the tumor was a malignant or osteogenetic sarcoma, and not until the improvement had begun was the opinion somewhat more in favor of a benign tumor.

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Publishers: Paul B. Hoeber, Inc., 67–69 East 59th St., New York City.

Twenty-Fifth Annual Meeting: Boston, Mass., September 3, 4, 5, 6, 1924. Headquarters and Meetings at the New Ocean House, Swampscott, Mass.

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Foreign Collaborators: A. Beclere, M.D., Paris. Gosta Forssell, M.D., Stockholm. G. F. Haenisch, M.D. Robert Knox, M.D., London. R. Ledoux-Lebard, M.D., Paris.

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Information of interest to all readers will be found on page vii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

THE RELATION OF ROENTGENOLOGY TO PATHOLOGY

The technical work of the roentgen department, including the production of roentgenograms and the setting in operation of the roentgenoscope, is but the preparation for the real medical work of the department, namely, the interpretation of the findings. The work of interpretation constitutes real medical roentgenology; hence it must be done by a physician. The better the technical work, the richer will be the roentgen findings for the medical roentgenologist to interpret; the greater his training, the more extensive his clinical experience, and the fuller his devotion to his work, the more will the medical roentgenologist see in the films and screen records of the case. Some roentgenologists perform the roentgenoscopic examinations in a perfunctory manner because they are able to gain little information, but the enthusiastic, well-trained, experienced clinical roentgenologist will find in the screen study of his patient a veritable mine of information and his ingenuity will constantly show him ways to reach out into yet unexplored fields.

Roentgen interpretation must be done by a physician who has had special training if the roentgen ray is to be utilized to the fullest degree. The gynecologist, for instance, in making a bimanual examination of the pelvic organs visualizes what he feels. In his mind's eye, he pictures in flesh and blood the mass which may be due to ovary, tube, fibroid, cyst or other pathological entity. In a similar way, the roentgenologist-interpreter must visualize in flesh and blood what he sees in shadow—not a crater, a defect, a displacement, an enlargement, a contraction, a thickening or a shadow, but the actual lesion. He must see the ulcer, the cancer, the tumor, the stricture, the cavity. This is relatively impossible without experience in pathology.

It is evident, therefore, that the aid of the pathologist is of the greatest importance both in the interpretation of roentgen findings and in the field of roentgen therapeutic endeavor. Whether directly, through personal conferences with the roentgenologist, or indirectly as a teacher and general reference aid, advantage must be taken of the pathologist's help if we are to approach maximum efficiency in roentgenology.

It would be trite to call attention to the analogy between the diagnostic work of the pathologist and the roentgenologist. The former deals for the most part with devitalized tissues secured either at necropsy or by excision of tissues *in vivo;* the latter works in living pathology. And it is gradually coming to be recognized that both these types of medical workers—the pathologist and the roentgenologist—already have or soon acquire a large and valuable experience which peculiarly fits them to aid the clinician who meets them in consultation. Indeed the term "clinical pathology" has already come into fairly general use and there are now recognized a number of clinical roentgenologists.

For the purpose of further stimulating close cooperation between pathologist and roentgenologist and to guide the editorial staff of this Journal in the differentiation of sound and unsound statements and conclusions in questions relating to pathology, editorial aid has been asked from three of the best known pathologists in the United States—Dr. James Ewing, Dr. Eugene L. Opie and Dr. Alred S. Warthin. We need to say nothing of the high standing of these men, each of whom occupies the chair of Pathology in a great university. They are all known as leaders in their special fields.

The Journal believes that it can render a special service to its readers and at the same time assist in placing roentgenology on a sounder foundation by enlisting the aid of these eminent pathologists.

JAMES T. CASE.

VOLUME ELEVEN NOW COMPLETE

In this number of the Journal will be found the Index to Volume XI, which is complete with this issue. The Index has been compiled with much care in order to give it the utmost possible value for future reference.

We would again call to the attention of our readers the importance of having their journals bound and keeping them for permanent reference. Even after the binder has eliminated the advertising matter from the six numbers comprising the present volume of the Journal, it will be found that there remain over six hundred pages of reading matter, consisting of carefully selected original articles and abstracts representing most of the important literature of the world on roentgenology and radium therapy. The reader receives two such volumes each year; and if he binds and preserves them it will be comparatively few years until he is in possession of an incomparable reference library.

It has been found by many that it is worth while even to preserve the advertising pages. These make a valuable purchasing index, and some who have had the binder remove the advertising matter and add it to the end of the volume have had reason for being thankful for their forethought; for, after all, the advances in *x*-ray apparatus are registered in our advertising pages.

THE LEONARD PRIZE

The American Roentgen Ray Society is again offering the Leonard Prize in 1925, and details appear on advertising page vi of this number of the JOURNAL. The manuscripts submitted for the previous prize were of a high order of merit and covered a variety of subjects pertinent to roentgenology. It is to be hoped that the contestants for the next prize will be equally zealous in their efforts.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL (*69 East 59th Street, New York*) *their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

COMBINED MEETING WESTERN SECTION OF THE AMERICAN ROENTGEN RAY SOCIETY AND THE PACIFIC COAST X-RAY SOCIETY SEATTLE AND RAINIER NATIONAL PARK

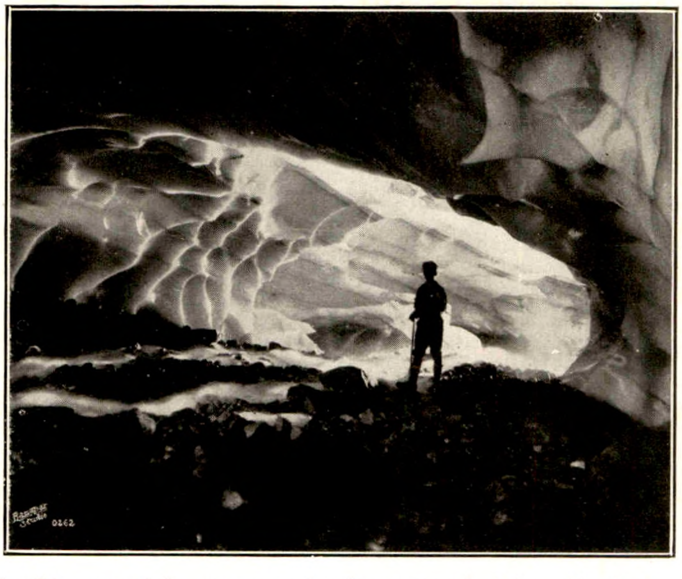
THE meeting will start with an open scientific session and dinner in Seattle on Monday, July 21, 1924.

The following day the delegates will go by automobile to Paradise Valley, Rainier National Park, where the meetings will be continued on the evenings of July 22 and 23, leaving the days free for horseback and walking trips to the many glaciers and wonderful scenic outlooks near by.

While the delegates are in the Park they will make their headquarters at Paradise Inn, that quaintly beautiful hostelry set amid the snows and flowers of Paradise Valley. The interior of the Inn is finished in Alaska cedar that had turned a silver gray through the action of the weather for thirty years in the silver forest farther down the mountain. This beautiful wood has also been used in a number of pieces of furniture—tables, chairs, and clocks—of heroic size placed about the great lobby.

The sessions on the evenings of July 22 and 23 will be held in the auditorium of the Guide House at Paradise Valley, where facilities are available for showing motion pictures and slides.

Continuing the sessions in Rainier National Park for the balance of the meeting will afford a wonderful opportunity to visit the Park with its great altar-like mountain that rises to a height of 14,408 feet, but 40 miles from sea-level. Its glacial system is the largest single-peak system in this country and one of the largest in the world; 28 glaciers cover the sides of the old volcano. The Nisqually, one of the seven "live" glaciers that move downward at the rate of from eleven to twenty inches a day, is nearly seven miles long, and has been selected by scientists as the type-glacier of the United States. The mountain is surrounded by a belt of wild-flower fields that extend from an altitude of 4,000 to 6,500 feet. These wild-flower areas occur in a series of alpine meadows that extend far up among the tenuous fingers of the glaciers, and frequently afford unusual vistas of beds of gorgeously colored wild-flowers blooming near fields of snow. The Park is indeed a botanist's paradise since some 417 varieties of wild-flowers grow there in greatest profusion.



Looking out of the entrance of an ice cave under Nisqually glacier

Party on sky-line trail, Rainier National Park.

Paradise Inn, elevation 5,557 feet, in Paradise Valley, Rainier National Park, Paradise Camp Service Building and Paradise Guide House to the left.

There are a number of regularly scheduled foot and horse-back trips under guide direction from Paradise Valley which will enable members to visit the glaciers and ice-caves and to enjoy the sport of snow-sliding or "nature-coasting" as they choose.

This is one roentgen-ray meeting that is sure to be enjoyed by everyone, and members are urged to take advantage of the opportunity to combine an outing with the furtherance of their professional interests in the company of kindred spirits. "See America First"—and bring the family.

INTERNATIONAL MEETING OF ROENTGENOLOGISTS

A plan is under way to have a meeting of roentgenologists of all countries in London and other cities of England and Scotland during July, 1925. Dr. Robert Knox and other prominent British roentgenologists are in charge of arrangements for the meeting. The tentative plans contemplate a meeting of several days in London, followed by visits to all of the important radiological centers in England and Scotland. Arrangements are also being made for tours through France, Germany, Austria and Sweden conducted by American roentgenologists who are well acquainted in each of these countries. It is hoped that a large number of American roentgenologists and radium therapists will avail themselves of this special opportunity to visit European clinics. As the plans are matured announcements will be made in this Journal, and those who are interested may receive additional information by corresponding with Dr. L. Jaches, 27 East 95th St., New York City, who is chairman of the American Committee of Arrangements.

NEW OFFICERS

NEW ENGLAND ROENTGEN SOCIETY

At the annual meeting of the New England Roentgen Society, May 23, the following officers were elected for the year 1924–25: President, Frederick W. O'Brien, M.D., Boston, Mass.; Vice-President, Philip H. Cook, M.D., Worcester, Mass.; Secretary-Treasurer, Frank E. Wheatley, M.D., Boston, Mass.; Member of the Executive Committee, Harvey Van Allen, M.D., Springfield, Mass.

FIRE HAZARD AND SAFETY

Editor, The American Journal of Roentgenology and Radium Therapy,
Washington, D. C.

Dear Sir:

In view of the increasing interest in the matter of roentgen-ray film storage, the writer feels that readers of the American Journal of Roentgenology and Radium Therapy will be interested in a short summary of the situation, with special reference to suggested methods of storage.

Doubtless the reason why this matter has not become a live one previously is because it is only in the last few years that there has been any considerable accumulation of these films in hospitals or laboratories. Roentgen-ray films were not in general use until after the war; the present type of film was devised and manufactured first for use in the United States Army during the war. It is true that roentgen-ray films were made prior to the war, but these were on film base with a single coating of emulsion. The present film is on a transparent base with an emulsion on both faces.

The earlier single-coated films were not a success because of their low speed in comparison with plates. Dupli-Tized films, however, are considerably faster than plates, and have come into universal use due to the fact that advances in technique not heretofore possible have been made. An obvious advantage, of course, is the light weight and thinness of films resulting in greater ease in handling and filing.

This summary is made to explain the "reason for being" of films.

There are at present only two types of film support which are used in any quantities at all—cellulose nitrate and cellulose acetate. Cellulose nitrate is the film base which is used for practically all classes of present-day films, including motion picture films, amateur films, cut sheet portrait films and roentgen-ray films. This is true both in this country and abroad, for cellulose nitrate has physical properties of toughness which are much to be desired. It is also less costly to manufacture. Cellulose acetate, which is commonly known as a slow-burning base, has, up to the present, been used only for non-theatrical motion pictures.

There has been a great deal of misinformation regarding the fire hazard involved in the case of roentgen-ray films; this is probably due in some measure to the fact that it is more or less commonly known that there are stringent regulations covering the use and storage of motion-picture films. When one reflects, however, that motion-picture films are in rolls weighing a number of pounds a piece (a solid mass of film)—these rolls consisting of film the back of which is bare cellulose support—and that in some exchanges there is as large a quantity as twenty tons, the difference will be appreciated. Roentgen-ray films are, it is true, coated on the same type of support, but on each face there is a coating of gelatin and silver salt, which appreciably reduces the rate of burning in the case of fire. It is also common practice to subdivide roentgen films in storage by placing them in manila envelopes, which further reduces the rate of combustion. Furthermore, even in the case of large consumers of roentgen films, there will rarely be more than a thousand or so pounds of this material on hand at any time. The risk in the case of any inflammable is, of course, proportional to the number of pounds present, to the rate at which the material will burn in the case of fire, to the precautions taken to prevent a fire and to the arrangements which have been made to minimize the seriousness of a fire in case it is started.

Because it is difficult in a good many instances for hospitals and private consumers alike to provide the proper fire-resistive rooms or vented metal cabinets which seem necessary for the storage of cellulose nitrate films, there are now manufactured roentgen-ray films on cellulose acetate support; these are known as "safety films." It is to be regretted that the present scale on which these films are manufactured and the higher cost of the materials entering into their making necessitates a higher price, but it is believed that with quantity production this can be reduced.

It should be understood that these films are not "noninflammable," but are slow-burning. Their combustion characteristics parallel the combustion characteristics of ordinary paper, and the films can be filed with no greater degree of precaution than is necessary in filing or storing paper records.

While the use of this slow-burning film may be the solution to the matter of film storage, there are in a great many instances a number of nitrate film negatives which it is desirable to keep, and the appended recommendations will be useful in caring for this situation. It should be understood that these are our own recommendations, which have not as yet been officially approved by national fire authorities. They have been used, however, as a basis of local ordinances in a number of places and there is reason to believe that the recommendations of the National Fire Protection Association will closely approximate this schedule. It is suggested that, when the matter of film storage comes up, those interested get in touch with local fire authorities—either the Bureau of Fire Prevention of the local fire department or local underwriter engineers—before making structural changes.

The recommendations for the storage of cellulose nitrate films follow:

GENERAL SUGGESTIONS

(1) In all rooms where roentgen-ray films are stocked, handled or filed, smoking should be strictly prohibited and conspicuous "NO SMOKING" signs posted.

(2) A metal can (preferably with spring-hinged cover) should be provided for all waste negatives and film scrap, and at no time should these be permitted to accumulate and lie around on tables, benches or floor.

(3) It is best, both as regards freshness of films and the reduction of fire hazard, to keep the stock of unexposed films at a minimum—the actual quantity depending on the ease with which fresh supplies may be secured from the dealer or distributor. Such stock should be kept in a cool, dry place out of the way of ordinary room

traffic, in a metal box or can. A lead-lined metal box or can is suggested, as this also prevents damage by roentgen rays.

(4) In rooms where films are filed or handled there should be no flames or any other than standard electrical fixtures. All open lamp bulbs should be protected from breakage by suitable guards. A hand fire-extinguisher should be kept in each room where films are handled. Any of the standard approved portable 2½ gallon extinguishers are satisfactory. Darkroom and other doors should be arranged so as to make egress from such rooms easy. It is also desirable, if possible, to have such rooms protected by automatic sprinklers.

(5) Film negatives should be filed as soon as possible in heavy manila envelopes, either singly or by case, and the filing of these so arranged that it is convenient from time to time to weed out useless negatives. The storage of film negatives in bulk without enclosure should be prohibited. In all places where films are handled or stored there should be no storage of other inflammable materials and no litter or accumulation of waste paper.

(6) Illuminators should be so designed that the diffusing glass is not hot to the touch and there should be no unnecessary display of film negatives in lighted illuminators. Negatives set up for viewing should be confined to those actually under inspection.

(7) If it is necessary to keep an active file of films for a current period of about a week, these should be kept in a metal container. Such a file should be limited to about 50 lbs. of films.

(8) Films should not be stored in the basement of any establishment.

SUGGESTIONS FOR FILING BULK STOCK OF FILM NEGATIVES

(1) Where it is necessary to keep the accumulated results of roentgen examinations for a period of months or years, it is obviously necessary to take certain further precautions to reduce fire hazard. In hospitals, where it is usually possible to secure additional space for such a purpose, a suitable room should be set aside for an exclusive and permanent bulk file of all negatives. Such a room should be located preferably at the top of the building and be of fire-resistive construction. Most modern hospitals have small rooms which could be made into virtually fireproof vaults by a few simple changes. There are only four basic requirements that should be satisfied:

(*a*) The room should be of fire-resistive construction.

(*b*) The room must have a direct outlet to the outer air.

(*c*) There should be a Class B, self-closing fire door at communication to building proper.

(*d*) The room should be additionally protected by automatic sprinkler heads operated from an adequate water supply.

As regards the vent opening into the room, this may be kept covered against the weather by glass or metal, but if such a protective device is used it should be arranged in a sash or so hinged as to open automatically in case of fire. This can be very easily arranged. If the room is not located on the top floor it is desirable in most cases to run a metal vent pipe from the outlet to the roof. The exact size of the vent depends upon the number of pounds of negatives stored and can be determined from the basic requirements that for each 1,000 pounds of film stock there should be 140 square inches of vent. Thus:

A circular opening of 13½ in. diameter for 1,000 lbs.

A circular opening of 9½ in. diameter for 500 lbs.

A circular opening of 6¾ in. diameter for 250 lbs.

As a guide in figuring poundage of stock the following table is useful:

1,000—14 × 17 negatives weigh approximately 118 lbs.

1,000—10 × 12 negatives weigh approximately 60 lbs.

1,000—8 × 10 negatives weigh approximately 40 lbs.

(Other sizes in proportion to area)

Relative to sprinkler protection, if there is no existing independent sprinkler water supply available, it will in a great many cases be acceptable to attach the film room sprinkler to the existing house water supply. There are of course standard specifications covering the necessary sizes of pipes, etc., for water supply to sprinklers; and the advice of someone in touch with requirements along this line should be obtained.

Where structural changes are necessary, or if it is desired to partition off a small part of an existing room, the partition can be most satisfactorily made by using expanded metal lathing on wooden "two by fours." There should be about ¾ in. of good grade cement plaster on the metal lathing, and it will of course make a more satisfactory looking room and add to heat insulation by putting this plastered lathing on both the inside and the outside of the room. If it is necessary to build a fire-resistive ceiling or floor, the same general type of construction will be satisfactory in most cases.

(2) In case such a room is not available and the quantity of films does not exceed a reasonable amount, reduction of the fire hazard is assured by the use of proper metal cabinets. These cabinets should be heat-insulated metal safes and be vented to the outside by metal pipes. Suitable safes of this type are available. The quantity of films which can be stored in such a manner is limited to 500 lb. in one safe and 1,000 lb. in two safes in any one room. If reduction of fire hazard only is desired, this type of safe will be generally suitable, but if it is also desired to save as many negatives as possible in case of a fire, the addition of a suitable sprinkler head in the top of the cabinet is necessary. If a safe containing more than 250 lb. of films is used it should be divided into two compartments, each separately vented. In case of a fire and the flooding of the contents from the sprinkler head, it is possible afterwards to reclaim most of the negatives which are merely wet by soaking them in water as soon as possible. The sprinkler-protected safe is the preferable system. In these safes and also in the virtually fireproof rooms previously mentioned, any convenient filing arrangement of films in envelopes may be used.

These suggestions have been carried out by a number of users of roentgen-ray films with satisfaction both with regard to safety of negatives and relations with underwriter bodies, and the attendant cost has not been excessive.

With regard to old negatives which are no longer necessary, and film scrap, these have a salvage value of about seventeen cents a pound. There are, however, certain shipping conditions which must be complied with.

These suggestions are not to be construed as applying to films in establishments where the general considerations of use and environment are substantially different from those in hospitals.

Very truly yours,

M. B. Hodgson.

Rochester, N. Y.,
May 16, 1924.

MEETINGS ON RADIOLOGY

AMERICAN MEDICAL ASSOCIATION

The Meetings on Radiology held on June 12 and 13 in the Section of Miscellaneous Topics of the American Medical Association were an unqualified success both from the standpoint of attendance and excellence of program. Many of the papers were valuable from a scientific standpoint and all were eminently practical in their application. The program was participated in not only by roentgenologists and radium therapists but by internists and surgeons. Not the least value of such a meeting is the exchange of ideas between the roentgenologist and the clinician. Misunderstandings are cleared away and each learns something from the other. Dr. Horsley, the Chairman of the Committee on Scientific Assembly, brought assurances from that committee of its sympathetic attitude towards the formation of a permanent section. It was well demonstrated that such a section can add something even to so great a meeting as that of the American Medical Association and there is no doubt that it would promote the best interests of roentgenology and radium therapy.

INTRAGASTRIC RADIUM APPLICATION
PRELIMINARY REPORT

BY THOS. O. MENEES, M.D.

Blodgett Memorial Hospital

GRAND RAPIDS, MICHIGAN

PINCH[1] placed radium in the stomach by having the patient swallow a tube on a silk thread, the position being determined by roentgenoscopy. This method is open to the serious objection that the relation of the radium to the stomach wall cannot be determined accurately, and an uninvolved area of mucosa might bear the brunt of the exposure.

A satisfactory method of applying radium to the interior of the stomach under roentgenoscopic control should define both the contour of the stomach wall and of the radium tube, thus permitting of accurate placing of the radium. An opaque barium mixture, dense enough to give sharp outlines, would obscure the tube. Air would give the requisite contrast to both, but would rise to the uppermost part of the stomach unless confined.

To meet these requirements, a rubber bag is cemented to the end of a rubber tube about 5 mm. in diameter (A in Fig. 1). The radium on the end of a flexible spiral spring is passed into the bag (B in Fig. 1). The bulb of a sphygmomanometer is placed in the upper end of the tube.

After a barium meal to outline the involved area, the tube is passed as an ordinary stomach tube, the radium container and spiral spring giving stiffness to the bag and preventing it from collapsing over the end of the rubber tube. When the roentgenoscope shows that the radium is in the portion of the stomach to be treated, the bag is inflated to bring out any irregularities of the stomach wall for landmarks, and the radium adjusted to the point desired. This adjustment is obtained largely by position of the patient, with the weight of the applicator carrying the radium into place. For example, the right lateral position will bring the radium close to the lesser curvature and assist in getting it into the pyloric end of the stomach. A strong thread on the radium tube inside the rubber tube will flex the spring and carry the radium closer to the stomach wall.

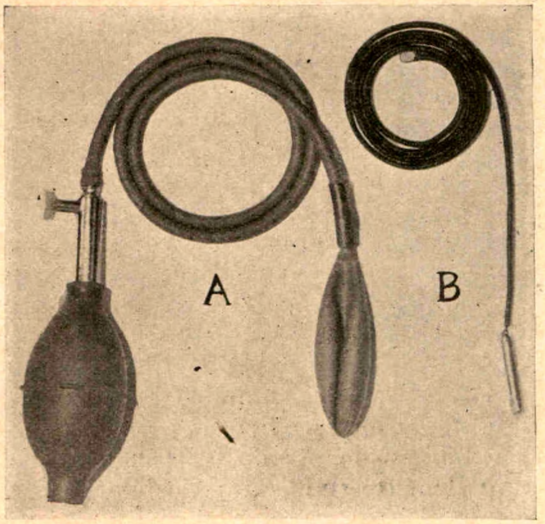


FIG. 1. A is tube with rubber bag and sphygmomanometer bulb. B is radium tube on spiral spring. In use B is inserted into A.

The attempt is always made, in cases with only one curvature involved, to get the radium in the closest possible contact with the malignant surface, the inflated bag holding the opposite uninvolved wall well away from the radium. With the whole circumference of the stomach involved at a given level the problem is much simpler. Then all that is necessary is to place the radium centrally in the lumen at the proper level.

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[1] Pinch, A. E. Hayward. Report of the Radium Institute, London, 1922, pp. 23–25.

Light filtration of 0.5 mm. of silver has been used. The small amount of beta radiation passing through this would probably be an advantage in shortening the time of exposure and giving a greater effect on the tumor with less generalized effect. Short exposures of not over two hours to an area have been given, repeated until the whole malignant surface is covered. Patients soon become accustomed to the presence of the tube and have no more distress than from a duodenal tube, provided the bag is not distended too much.

While it is too early to report any permanent results, the method is of value in checking hemorrhage, relieving pain, delaying ascites and in opening up narrow portions of the stomach lumen and preventing impending obstruction. In conjunction with high voltage roentgen therapy, it will increase the quantity of radiation delivered to the tumor, with little increase in radiation of the skin and adjacent viscera, and thus possibly be of curative value.

A NEW DESIGN FOR AN ILLUMINATING BOX

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BALTIMORE, MARYLAND

PHYSICIANS are becoming increasingly interested in the study of roentgenograms of their patients. There are, however, serious objections to the illuminating devices in common use. The use of several 100–150 watt lamps, with the consequent high degree of heat, necessitates metal construction which is usually heavy and cumbersome.

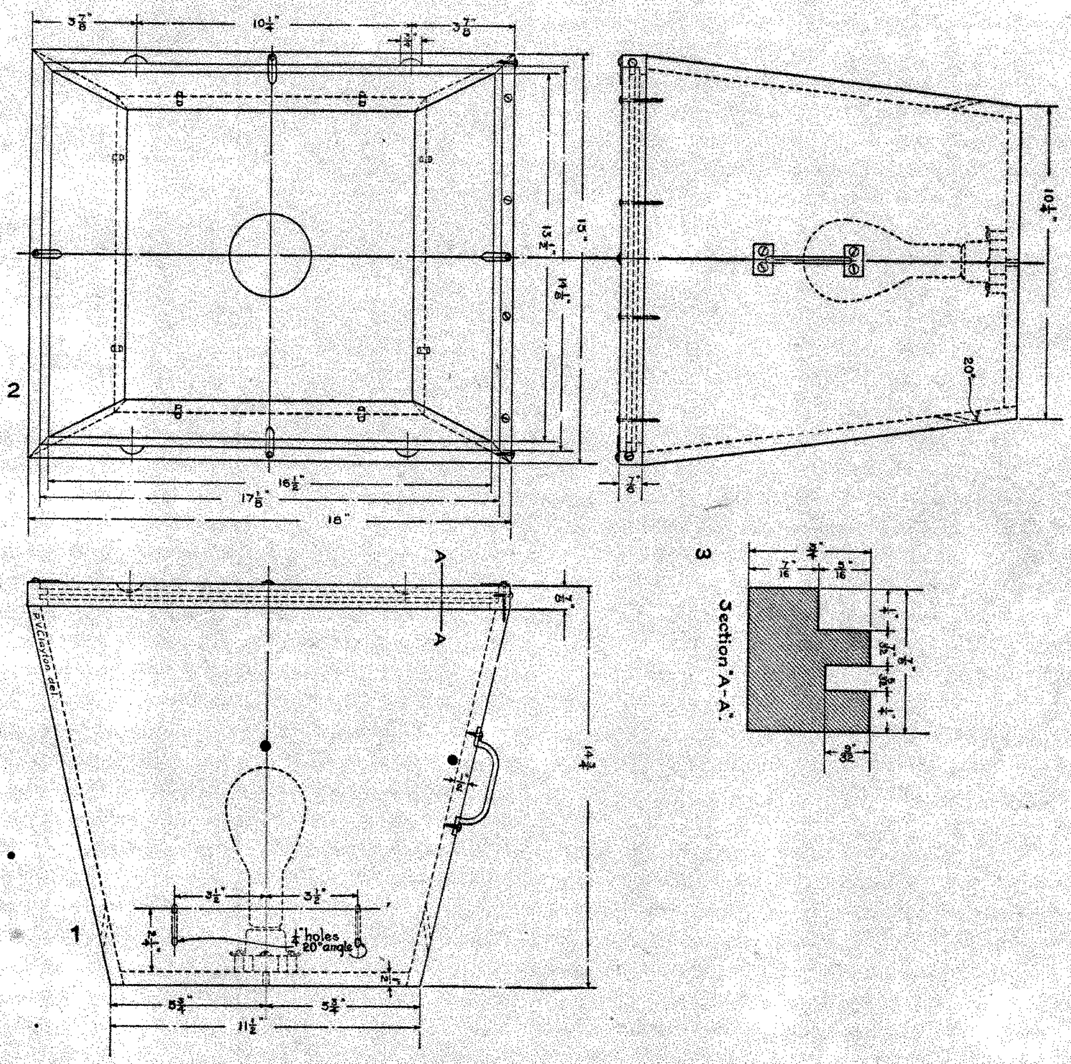
To overcome these objections several models were made to ascertain a method of obtaining an equally even and brilliant illumination through the use of only a single lamp.

The clear, even illumination depends upon direct-indirect lighting, which is obtained by using a 100 watt half-frosted lamp. This frosting allows the light rays to pass to the front of the illuminator without giving a concentrated central illumination or unevenness from the glowing filaments. The posterior unfrosted portion of the lamp throws its rays upon the white surfaces of the sides and back of the box and the rays are reflected forward. Flash opal glass measuring 13⅞″ × 16⅞″ is absolutely necessary. Experiments with frosted glass or parchment paper behind clear or frosted glass indicate that these are not adequate substitutes when only one lamp is used. There is a lack of brilliance and the illumination is uneven. Access to the entire box is readily obtained by pulling upward and removing the opal glass, which is held firmly in place by the upper facing strip. This strip is attached by four inward and two downward screws (D, in sketch), while the remainder of the facing forming the frame is rigidly fixed. Well-seasoned white wood is necessary to lessen weight and heating. The rigidity of the box depends greatly upon the ends. If very rough usage is anticipated, quarter-round, half-inch strips should be used along all inside joints (A, in sketch). This makes the box extremely rigid and resistant.

Of importance is the painting of the inside and outside of the box. Five thin coats of flat white are essential on the inside of the box. The filling effect on the wood prevents the action of heat or dampness and gives a white reflecting surface. The outside requires only two coats of flat black, which results in sufficient filling and gives a finished effect.

Ventilation, which had to be considered, was obtained by drilling at a 20° angle eight holes, two to a side. These are ¼ in. in diameter and give the necessary cooling, while the angle used allows no radiation of light from the box. Ten hours' continuous use of this illuminating device with a 100 watt lamp has never heated the back or walls beyond a moderate warmth.

The opal glass does become somewhat heated. The ability to turn the box on any side and have a slanting surface upon which a plate may be placed with only a slight chance of its slipping or falling off, is considered of much importance. Clips of thin brass hold the plate or film firmly in place when carrying the box. These clips may be added to the facing as desired, but require a washer under each (C, in sketch). By cutting L-shaped cardboard placques with the outside dimensions 14″ × 17″ and inside measurements similar to the smaller plates to be shown, any size of plate is easily placed in the illuminating box for demonstration. This non-use of curtains considerably lessens the first cost and later replacements. Dowls as indicated in the sketch and in the drawings (B, in sketch) aid greatly in removal of plates. A brass handle is placed on the top as a matter of convenience. As a fire hazard, assurance has been given that with correct insulation of the wires entering the box and proper porcelain mounting for the single lamp, the hazard is negligible.



Figs. 1, 2 and 3.

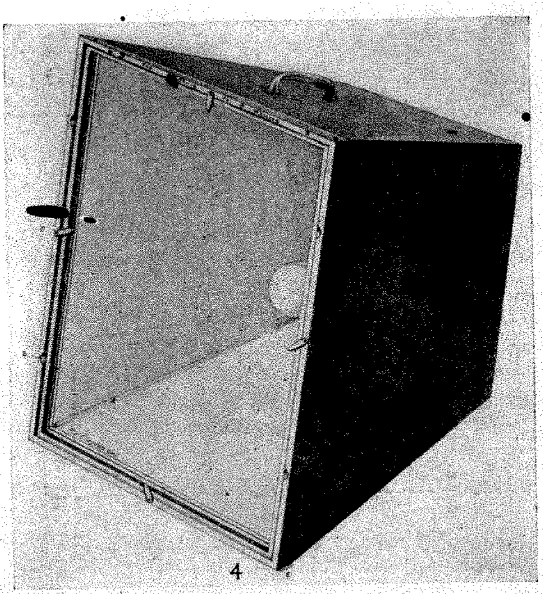


Fig. 4.

SUMMARY

1. A simple, inexpensive, easily made, illuminating box, holding any size of plate or film is described. The estimated cost is \$9.75.

2. It is compact, of neat appearance and gives a perfectly even illumination with one 100 watt lamp. The device is in no way intended to replace the usual box required for stereoscopic studies, but it does give an opportunity to have several illuminators in the same building instead one or two expensive boxes with curtains, several lamps and an unnecessary current consumption. But especially is it intended for physicians in rural districts.

3. The surface angle is a very definite aid. The light weight (9¾ lbs.) makes the illuminator easily portable, and its size requires little space in an office or automobile.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

RADIUM, X RAYS AND THE LIVING CELL, WITH PHYSICAL INTRODUCTION. By Hector A. Colwell, M.B. (Lond.), D.P.H. (Oxfd.), Assistant Radiologist, King's College Hospital, and Sidney Russ, D.SC. (Lond.), F. Inst.P., Joel Professor of Physics, the Medical School, Middlesex Hospital, Fellow of University College, London. Second edition, revised. Cloth. Pp. 365, with 62 illustrations. London: G. Bell and Sons, Ltd., 1924.

The first edition of this work appeared in 1915. The scope of this, the second edition, has been extended to include recent experimental results; although out of approximately 500 bibliographical references only about 70 relate to literature of the last decade. Although the authors do not approach the subject from a clinical standpoint the reader is apt to be disappointed that some of the commonly observed clinical phenomena are not incorporated. This may be illustrated by quoting in full the paragraph relating to the salivary glands. "Horowitz inserted his 1 mgr. tube of radium bromide into the submaxillary salivary gland of a rabbit; it was left *in situ* for ten days. The organ did not show itself very sensitive to irradiation, though local destruction of glandular tissue occurred, repair being effected by the formation of fibrous tissue." This, of course, does not harmonize with the experience of those engaged in the clinical application of roentgen rays and radium. In spite of such discrepancies the book is one that merits careful study by everyone using these agents therapeutically.

The discussion of the physical properties of roentgen rays and of radium commends itself particularly to roentgenologists who are not physicists in that it is sufficiently non-technical to be readily understood and complete enough to give adequate knowledge of the subject. Chapters are devoted to consideration of the effects of irradiation upon unicellular animal organisms and to the development of more complex animal forms such as nematodes, molluscs, fishes, amphibia, birds, insects, and mammals. Chapters are also devoted to discussion of the results of irradiation upon the growth of various plant forms and of bacteria. A considerable portion of the book deals with the effect of roentgen rays and radium upon various tissues of the body including the skin, blood, spleen, thymus and thyroid, digestive tract and glands, the nervous system, the eye, muscle, cartilage, connective tissue, and the generative system. There is a very satisfactory chapter upon the effects of irradiation on malignant cells.

The entire book will be read with interest and profit and will be found valuable for reference.

THOMAS A. GROOVER.

LECTURES ON ENDOCRINOLOGY. By Walter Timme, M.D., Attending Neurologist, Neurological Institute, New York; Professor of Endocrinology, Broad Street Hospital; Professor of Nervous and Mental Diseases, Polyclinic Medical School and Hospital. Price, $1.50. Pp. 133, with 27 illustrations. Paul B. Hoeber, Inc., New York, 1924.

This book of lectures is written in the author's clear and concise manner and gives an unusual amount of logical and conservative information based on the recent studies of the endocrines. The sequence of the physiological manifestations of these glands is brought to the reader's attention in a way that makes them easily understood and easily remembered. No phase of the work is slighted, but particular emphasis is given to those studies most useful in leading to a practical and rational treatment of diseases of the endocrines. Though the details of such treatment are not discussed, the book gives excellent material for the student of endocrine physiology, and is helpful to the experienced clinician who may easily formulate his own medication. Of exceptional interest is the clear-cut description of the relationship of the pathological conditions of the pituitary and thymus glands. No vague hypotheses or untried theories are considered. The facts included are substantiated by the experimental work of a number of leading authorities whose articles are systematically noted in a large bibliography. The volume is profusely and clearly illustrated with cuts showing striking examples of the typical conditions, as well as some of the rare conditions.

R. L. SEXTON.

RADIUM REPORT OF THE MEMORIAL HOSPITAL, NEW YORK. (Second Series, 1923.) Cloth. Price, $5.00. Pp. 293, with 55 illustrations. New York: Paul B. Hoeber, Inc., 1924.

During recent years there has been a voluminous literature on radium therapy—some of it of value, but much of it based upon insufficient clinical material and the use of too small a quantity of radium, and much of it actually misleading. Such a book as the Radium Report of the Memorial Hospital is, therefore, especially welcome at this time. It is a report of results obtained over a period of several years, on a very large number of patients, by the staff of a hospital especially trained in the diagnosis and treatment of malignant disease, who have at their disposal a large quantity of radium which they can utilize as emanation or otherwise as they choose.

What the authors are attempting to show by the present report is indicated by the following quotation from the first article in the book: ". . . During the past four years, well-supported conclusions regarding the method of choice for different lesions and regarding safe and efficient dosage have been reached. In other words, standards for treatment have been established which are reliable and are possibly a close approach to the best. Moreover, a knowledge of what can be accomplished by radium in the various forms and stages of malignant growths has been acquired, so that a very accurate prognosis can now be given at the outset of treatment. This knowledge was not acquired sufficiently early for its incorporation in the present publication in the form of records of apparently complete retrogressions. The period covered by this report, like that of the preceding one, has been a period of growth; an attempt to discover just what radium is able to accomplish in the cure of cancer; a period of development of methods and dosage; of determining what forms of cancer can be benefited by radium and to what extent."

The report consists of articles by various members of the Hospital Staff and embodies the conclusions of the surgeon, the radiologist, the physicist, and the biologist. Every aspect of the use of radium is considered. Under "Technical Principles" the physics of radium are dealt with and the advantages of the use of disintegration products briefly explained. Six methods of using radium are described and it is stated that "the results of treatment of malignant growths by radium are largely dependent upon the methods of application," and that "each one of these different methods may be regarded as a separate therapeutic agent." The technique for the use of radium in various localities is described in the different articles.

There will be found in the report a careful statement and interpretation of results of radium treatment in practically all malignant conditions, including those of the intraoral group, the parotid, the eyeball and orbit, the skin, the female generative organs, the rectum, the breast, the prostate, the bladder, the testicle, and the penis.

The report concludes with the Mütter Lecture by Ewing, entitled "An Analysis of Radiation Therapy in Cancer," and is a summary of the development and the present status of radiation therapy. Everyone who treats malignant disease, whether he is a surgeon, a roentgenologist or a radium therapist, can read this lecture with profit. It is at once a warning and an inspiration. A careful study of the entire report will impress the student with the fact that a small quantity of radium and an unbounded enthusiasm are not the only essentials for the treatment of malignant neoplasms. He will recognize first, the necessity for accuracy of diagnosis of the various types of malignant growths; second, the need for accuracy in dosage; third, the need for careful consideration of each individual case with regard to the type of malignant disease present, its location, the presence or absence of metastases, and the proximity of important structures which may be injured by the treatment; and fourth, the necessity for classification of the cases into those in which complete regression may be hoped for and those in which only palliation may be expected.

No one who treats malignant disease in any of its forms should fail to avail himself of the experience so admirably described in this book.

A. C. C.

BOOKS RECEIVED

The Prevention of Dental Caries and Oral Sepsis. By H. P. Pickerill, c.b.e., m.d., Professor of Dentistry and Dean of the Dental School in the University of Otago; Membre d'Honneur Societe Belge de Stomatologie; Fellow of the Royal Society of Medicine. Third edition. Cloth. Price, $6.00. Pp. 340, with 80 illustrations. New York: Paul B. Hoeber, Inc., 1924.

The Treatment of the Common Disorders of Digestion. By John L. Kantor, ph.d., m.d., Chief in Gastrointestinal Diseases, Vanderbilt Clinic, Columbia University; Associate Gastroenterologist and Associate Roentgenologist, Montefiore Hospital for Chronic Diseases, New York City. Cloth. Price, $4.75. Pp. 245, with 64 illustrations. St. Louis: C. V. Mosby Co., 1924.

Lehrbuch der Rontgendiagnostik. Herausgegeben von A. Schittenhelm. Band I and II. Paper. Price, $7.65. Pp. 1283, with 1032 illustrations and 3 tables. Berlin: Julius Springer, 1924.

CHIROPRACTOR'S X-RAY AND PATHOLOGICAL LABORATORIES ARE CLOSED

The New York *X*-ray and Pathological Laboratories, a trade name for the *X*-ray and Dental Laboratories, Inc. (Edward L. Crusius, "Sc. R.", President), went into the hands of a receiver last week, and were sold out at auction.

Their stock-selling campaign was exposed by the Medical Week in a series of six articles, a year ago last fall. Acting on this information, it is apparent that few physicians were so unwise as to buy this stock, but unfortunately, too many physicians and dentists patronized them. True to form, they betrayed this support and pointed with pride to it in their advertisements in the daily press, written in the usual style of quack literature. They appealed to the public and tried to broadcast their book, "The Open Door to Health."

The Medical Society of the County of New York has for some time recognized that there are many irresponsible laboratories springing up in the city, and offered caution and advice to physicians in general in a resolution that: "As a matter of public policy it is recommended to the profession that their support of commercial laboratories be withdrawn, and wherever possible, patients be referred to laboratories under supervision of competent and qualified medical men."

For the enforcement of this action they took further steps in their "Rules and Regulations for Approval of Clinico-Pathological and *X*-ray Laboratories." The certificate of the Medical Society of the County of New York issued to the Director of a laboratory, shows at once that the standards of the Society have been met.

It is believed that if the licensed medical man operating a clinico-pathological and *X*-ray laboratory would ask for this recognition, the unqualified technician would automatically be eliminated. This, of course, goes on the supposition that physicians at large would support their county society by withholding patronage from laboratories that fail to meet its requirements.

From the New York Medical Week, Official Organ of the Medical Society of the County of New York, April 12, 1924.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

Battle, Wm. H. The clinical diagnosis of carcinoma of the breast. *Lancet, Lond.*, January 5, 1924, ccvi, 1–5.

H[illegible] states that out of 300 cases of disease of the breast occurring in persons under 25 years of age, 128 were incorrectly diagnosed; and that out of 3,562 cases, 582 were sent to a London hospital with a wrong diagnosis. The early manifestations are without pain or discomfort, making the essential early diagnosis difficult to obtain. Many errors in diagnosis are due to imperfect examination. Swellings which occur in the breast are cysts, fibroadenomata and chronic inflammatory processes. It is difficult to distinguish these conditions from early carcinoma; when cysts or fibroadenomata are associated with a chronic inflammation the diagnosis is impossible.

Beeler, Bruce H. Cancer of the rectum. *Am. Med.*, January, 1924, xix, 44–47.

Carcinoma is more common in the rectum than sarcoma; and adenocarcinoma is more common than epithelioma. In Williams' tabulation of 7,327 cases of malignant growths, there was involvement of the rectum in 7.5 per cent. Every growth with a hard, diffuse infiltrated base about the rectum should be regarded as malignant unless it can be proved benign. All adenomatous growths which are benign have a pedicle.

Berberich, J., and Hirsch, S. Roentgenographic demonstration of the arteries and veins. *Klin. Wchnschr.*, 1923, ii, 2226–2228.

By injecting 5 to 10 c.c. of a 10 to 20 per cent strontium bromate solution into the circulation, and hindering regurgitation by central compression, the vessels can be well demonstrated if the roentgenogram is made at once. This procedure acts upon the principle of the Bier venous anesthesia, and the arterial anesthesia of Goyane and v. Oppel. Some pain is sometimes experienced upon injection under pressure. Infiltrations which may occur are absorbed within 24 hours. Roentgenological demonstration of circulatory connections, vascular spasms, and blood supply, in connection with amputations and transplantations, may thus be observed.

With the aid of a special solution of iodid and brom oil, it was possible to observe the migration of a drop of oil from the point of injection to the heart and into the lungs of a rabbit, and recently also in the human on the screen. In man, the spinal cord was demonstrated roentgenologically, with the aid of strontium bromatum.

Bernhardt, H. Pathogenesis of roentgen sickness. *Klin. Wchnschr.*, 1923, ii, 1795–1796.

The cause of hypochloremia following radiation must be the influx of fluid into the circulation. This would be proven by the erythrocyte count in the dry substance of the blood. However, not only the changes in the water and salt metabolism can be the cause of roentgen sickness. For, if that were the case, a relative decrease in the serum albumin values would occur. This, however, is not the case. The primary cell injury by radiation may, with a certain degree of accuracy be measured by the changes in the uric acid and phosphoric acid metabolism. It was found that in cases where such cell injuries became manifest, the refractometric values of the serum maintained their same height in spite of distinct thinning of the blood, and this was especially marked in the cases where roentgen sickness was excessive. The effect upon the body albumin is of importance for the genesis of the symptomatology. These findings corroborate the explanation given on the basis of other methods, by Neuda, Redlich, and Simon.

Boothby, Walter M. The importance in surgery of the thyroid gland of the correct differential diagnosis of thyroid diseases. *Ann. Surg., Phila.*, November, 1923, lxxviii, 572–576.

Plummer classifies thyroid disease into 9 distinct types; (1) diffuse colloid goiter. This type on palpation feels like exophthalmic goiter, and therefore in a nervous unstable person with symptoms of "effect syndrome" or "disordered action of the heart," a mistaken diagnosis of exophthalmic goiter is made. Patients with diffuse colloid goiter are safe operative risks; (2) adenomatous goiter without hyperthyroidism. In most cases these nodular masses are surrounded by a definite capsule, and even without a capsule can be recognized as true tumors, grossly and developmentally different from the diffuse enlargement of exophthalmic and from diffuse colloid goiter; (3) adenomatous goiter with hyperthroidism. This is a distinct constitutional disease due to the unregulated concentration of thyroxin in the body, causing an increased basal metabolic rate with the resulting secondary manifestations; (4) exophthalmic goiter. This is a constitutional disease, apparently due to excessive secretion of the gland, characterized by an increased metabolic rate. The cause of the altered pathology and disturbed function of the thyroid gland is not known; (5) myxedema; (6) cretinism; (7) myxedema of childhood; (8) thyroiditis; and (9) malignant disease of the thyroid.

CZEPA, A., and HÖGLER, F. Pathogenesis of roentgen and radium sickness. *Klin. Wchnschr.*, 1923, ii, 2341–2344.

Chemical changes in the blood cannot be the only cause of roentgen and radium sickness. They are only the indicators of the changes in the tissues. Undoubtedly roentgen and radium application is followed by cell degeneration, and products of metabolism and toxic products are probably liberated. Roentgen cachexia may be compared to protein cachexia. Albumin autolytic processes follow injections of protein bodies, and often cause severe disturbances in the general condition of the body, even amounting to severe vomiting. The complex problem of roentgen disease parallels the complex problem of protein body action. Provocative roentgen effects, such as produced by provocative radiation of the spleen and the ovaries are very probably only secondary roentgen effects, which might be produced in a similar manner by protein injections.

DIBLE, HENRY J., and MORISON, J. M. W. Observations on *x*-ray cancer. *Arch. Radiol. & Electroth., Lond.*, August, 1923, xxviii, 65.

The prognosis of roentgen-ray carcinoma seems very varied. Of 11 cases in 1907, 5, and possibly 6 ended fatally. In one class of cases the disease spreads rapidly, in another it tends to remain localized. One case is mentioned which was under treatment for cancer for 5 years and in which 27 minor operations were performed; the disease remained confined to the fingers.

CASE, J. T. Comparative effects of deep roentgen-ray therapy at low and very high voltage. *J. Am. M. Ass., Chicago,* January 19, 1924, lxxxii, 208.

The problem discussed is whether in giving a definite dose, 400 ma-min., for instance, one should employ 2 to 5, or 25 or more milliamperes of current, keeping the patient on the table 200, 80, or 16 minutes. Some have felt that since mitosis is constantly going on, the slower method would be best; others, that the physical results would be in proportion to the energy applied and that the physiologic results would parallel the physical results without reference to the time factor, this being true in epilation of hairy parts for ringworm.

Coolidge has recently invented a new therapy roentgen-ray tube, water-cooled, capable of a continuous output of as high as 50 ma. at 250,000 volts. The new tube has been used in the clinic with high milliamperage and voltage readings, and work formerly demanding from 3 to 4 hours may now be concluded within 15 to 18 minutes, with an average dose of only 5 to 10 minutes. The routine work was done with 25 to 30 ma. at 200,000 to 210,000 volts on the tube. The tube permits also the use of as low a current intensity as one milliampere.

Given a fixed dose of 450 ma-min., is there any difference in the clinical effect if the application is made at the rate of 2.5 ma. per minute or at the rate of 25 ma. per minute? The experiments made since August 1, 1923, with the time difference in the ratio of 10 to 1 show that the physiological and clinical effects are directly related to the amount of energy applied, regardless of the time factor. The water-cooled tube allows of shortening greatly the time of application of any desired dose without prejudicing the results to be expected and there is as well a diminution of the frequency and severity of the post-irradiation sickness, although the total amount of irradiation at one sitting has not been cut down.

DODDS, E. C., and WEBSTER, J. H. DOUGLAS. Metabolic changes associated with *x*-ray and radium treatment. *Lancet, Lond.*, March 15, 1924, ccvi, 533–536.

Interest in roentgen-ray toxemia centers on the biochemical changes resulting from exposure to roentgen ray. Psychical causes can be at work only to a limited extent. In temporary depression of the functions of the kidneys or in a toxemia from definite organic products of proteolytic or autolytic changes (possibly anaphylactic), or in inorganic disturbance from acidosis or other metabolic changes, the essential causes are now being sought.

The patients studied were from four clinical groups: (1) Cases of leucemia; (2) cases of exophthalmic goiter; (3) prophylactic postoperative radiation of breast cases; and (4) radiation of patients with malignant disease in various parts of the body. Cases in Group (1) were treated with radium to the enlarged spleen with or without roentgen radiation to the long bones or enlarged glands. Cases in Group (2) were treated with roentgen radiation to the thyroid, and in some instances, the thymus. A shorter roentgen-ray wave-length was used in a few of Group (3) and in all of Group.

(4). Thus a wide range of roentgen and gamma wave-lengths was used. Attention was mainly confined to the urine, though some blood observations were made. The results were complicated by the disease, the effect of treatment on the disease and the effect of the rays on the metabolism of the individual. All of the patients were in bed on a constant diet; 24-hour specimens of urine were collected. All cases were examined for a week previous to the treatment to get the normal of their urinary constituents. Each specimen was examined for volume, urea, uric acid, ammonia acidity, total nitrogen, ammonia coefficient, phosphates, chlorides, creatinine, and diastate.

The results are classified under four headings: (1) Abdominal irradiation. There were 5 of these cases, in all of them there was a profound effect on the urine; (2) thyroid or cervical irradiation. There were 2 of these cases, the results in each being quite different. There was no marked change in any of the urinary constituents, excepting creatinine, which practically disappeared from the urine during the period of irradiation, not reaching its normal level for four days; (3) thoracic irradiation. No changes were found; and (4) other parts of the body. No changes were found.

The blood findings in all four groups show a marked fall in blood urea content, with little change of other constituents. There was a rise of fecal fat content in cases of abdominal irradiation, but not with other parts of the body. No change in metabolism was produced. Cases treated prophylactically with calcium chloride and sodium bicarbonate showed less reaction.

There is a bibliography of eighteen references.

Eskuchen, E. Abdominal aortic aneurysm with mention of special roentgenoscopic symptoms. *Klin. Wchnschr.*, 1923, ii, 2202–2205.

The writer is of opinion that abdominal aortic aneurysm is more frequent than is generally accepted. In the municipal hospital at Altona 7 cases were found among 9,500 autopsies. The author reports on 8 cases. In one of the cases insufflation of the large intestine revealed the pulsating aneurysmal sac, and later on the specimen showed roentgenologic structural changes in the spinal roentgenogram. In 2 other cases they were seen in the living. The characteristic defect is represented by an area of erosion which is delimited by a convex arch. Sometimes light spots are seen in the region of the lower two insertions of the ribs instead of in the vertebræ. Seven times out of 8 pain at the root formed the clinical manifestation. In one case of erroneous diagnosis there existed an aneurysm of the splenic artery.

Ferrannini, A. Interstitial broncho-pulmonary carcinosis. *Riforma med.*, 1924, xl, 63.

In this condition the patient suffers from gradually increasing dyspnea and from perpetual cough which is in contrast to the scanty mucous expectoration. The thoracic pain is slight and deep seated. Cyanosis and the sense of asphyxiation slowly increase. No rise in temperature is noted; it may be subnormal. These symptoms come on in attacks, with intermissions, but the cough is persistent. During the final stage, some pleuro-pulmonary crepitation is heard.

Volta and Valenti have made detailed pathologic reports of postmortem examinations. They found cancerous cell infiltation in the interstitial lymphatic system of the pleura and lungs. The neoplastic cells were distributed along the lymphatic tracts of the interlobar sections, the peribronchial and perivascular spaces, and the lymphatic capillaries communicated with the sinusoidal lacunae of the pulmonary tissue.

In the roentgenogram the lesions appear like diffuse interstitial peribronchial sclerosis. The picture remained the same until death and closely resembled that of the roentgenogram taken after death.

Fox, Howard. The roentgen ray in the treatment of skin disease. *Arch. Dermat. & Syphilol.*, January, 1924, ix, 13–37.

Care should be taken not to produce an erythema and strong skin irritants should be avoided for one or two weeks both before and after treatment. It is inadvisable to irradiate a skin after application of metallic ointments, as metallic particles may generate secondary rays, and intensify the action.

Among the conclusions which the writer reaches, are the following: With modern apparatus the roentgen ray can be accurately measured and with proper precaution it may be employed with safety; the versatility of the roentgen ray is shown by its favorable action in such varying conditions as inflammatory and functional diseases, granulomas and neoplasms; the roentgen ray is the best local remedy for routine treatment of acne vulgaris, eczema, seborrheic dermatitis and lichen planus. In rosacea it is unsatisfactory, except for its favorable effect on the acne-like lesions. In psoriasis it should be used with caution and only in selected cases; the curative action in ringworm and favus of the scalp is one of its greatest achievements. Good results also follow in sycosis and folliculitis; as a palliative in anal and vulvar pruritis and in localized hyperhidrosis, it is invaluable; in lupus erythematosus it is of little or no value, and in hypertrichosis its use is in general contraindicated; the roentgen ray is a most valuable agent in treatment of skin disease.

Fraenkel, M. Relationship of thyroid gland and genitals in both sexes. *Deutsche med. Wchnschr., Berl. & Leipz.*, January 25, 1914, l, 108–109.

The relationship between the thyroid gland and the generative organs has long been known in the female, but not in the male. The author found this correlation in two men. In both, the testicles became swollen upon radiating the thyroid. This finding is explained on the basis of a radiosensitiveness of the testicles which exceeded the normal physiological limit.

In addition to these 2 cases, the reports include 8 of severe roentgen burns, in patients who had been given salvarsan, iodides or bromides. The burns were seen after screen examination, with aluminum filter, or upon treatment for myoma. Caution is therefore advised in these cases, where roentgen treatment is given. Probably very slight unrecognizable injuries from iodides and bromides, acne, or salvarsan exanthema had existed before roentgen treatment, with a marked cutaneous tendency to reaction. Two other cases which had been treated with pyrogallic acid for lupus suffered from severe roentgen burns. Three patients who had been treated for syphilis with bismuth showed marked roentgen sensitiveness, and also two children who had been treated with diphtheria antitoxin.

Gütschow, A., and Walter, F. Ostitis deformans (Paget). *Klin. Wchnschr.*, 1924, iii, 71–73.

In two cases of ostitis deformans the roentgenogram was so typical and differed from the picture seen in ostitis fibrosa so that there could be no question as to the diagnosis. In both cases the continuous arched form of the tibia with diffuse involvement of the entire length and breadth of the bone was shown. In one of the cases there was an extensive sclerosis of the tibia, in the other transparency of the entire bony substance was marked. In the latter case, however, the typical hollow spaces characteristic for ostitis fibrosa were absent; instead there was a large meshed fibrous network. In regard to the so far unexplained pathogenesis, the author remarks that the entire course of the posterior tibial artery could be observed in the roentgenogram in an old lady, aged 76. This finding might lend support to the theory that the cause of this disease is an atheromatosis of the blood vessels.

Klewitz, F. Short report on eighty-five cases of asthma treated with roentgen rays. *Klin. Wchnschr.*, February 5, 1924, iii, 228–229.

The author reports success in 75 per cent of 85 cases of bronchial asthma. In 30 per cent the attacks did not recur after radiation; in 45 per cent attacks recurred but were much less severe, and when the treatment was given again renewed improvement was experienced. As to technique, the writer refers his readers to a previous publication (München. med. Wchnschr., 1922, lix, 305–306). Briefly the technique is as follows: Seven fields of from 10 to 15 cm., 4 on the back, and 3 on the chest are radiated. To each a third of an erythema dose is applied. After 4 weeks another treatment is given.

Lehmann, J. C. Additional remarks concerning the "gastric-tract." *Arch. f. klin. Chir., Berl.*, 1923, cxxvii, 357–375.

A chronic ulcer of the stomach is, almost without exception, located upon the lesser curvature, and the "gastric-tract" is usually considered the cause, because the ingesta, following this tract, give rise to mechanical, chemical, and thermic injuries. This general and common idea of the existence of a sewer system at the small curvature was criticized in 1919 by the anatomist, Elze. Based on roentgen examinations Katsch reached, two years later, conclusions similar to those of Elze. The old opinion still finds its adherents.

In order to prove Elze's contention on living material, the author tried to make the small curvature visible by help of thin, soft Einhorn duodenal probes. The experiment was successful, and disproved what had been feared, namely, that the ingesta would be forced to pass at the side of the probe because the probe had smoothed the "gastric-tract" in its neighborhood. Forty stomachs with the small curvatures marked as stated, were examined and the following result was reached: When the empty stomach is in its normal, perpendicular position, and when no parts of the intestine displace it, the ingesta use (corresponding to what Elze found in stomachs at autopsy) the road over the small curvature below the cardia, for a small distance only, and then turn more or less away in a downward direction. To characterize the longitudinal folds at the small curvature as the "gastric-tract" is improper because the name would indicate a function which does not exist. According to the above experimental results there is little probability that a mechanical injury would be the cause of gastric ulcer. It has been argued that small quantities of irritating liquids, when taken internally, are found almost exclusively in the "gastric-tract". at the small curvature; the writer meets this argument by stating that the quantities are too small to distend the stomach, and mechanically remain adhering to the folds of the cardia at the small curvature.

MacCready, P. B., and Crowe, S. J. Tuberculosis of the tonsils and adenoids. *Am. J. Dis. Child., Chicago,* February, 1924, xxvii, 113–138.

Since 1912 all tonsils and adenoids removed at operation in the Johns Hopkins Hospital have been studied histologically; of these there were 3,260. One of the conclusions reached is that tuberculosis of the tonsil is usually caused by the bovine type of the tubercle bacillus. This conclusion is based on age incidence, 50 per cent of the patients being less than ten years old; frequency of involvement of the cervical and mediastinal glands; the strikingly low incidence of pulmonary, intestinal or other complications during the period of postoperative observation; and the growth and excellent general physical condition of the children in spite of the roentgen-ray evidence of tuberculosis of the mediastinum. It is possible that such tuberculous infection of the lymphadenoid tissue in the throat is of value from the point of view of immunity.

When histological examination reveals tubercles in the tonsil the infection is likely to be widespread. The removal of tonsils and adenoids reduces secondary infection in these cases but there is no assurance that the only tuberculous focus in the body is destroyed. Tuberculosis of the tonsils and adenoids cannot be recognized grossly unless there are superficial ulcerations secondary to a pulmonary lesion.

An extensive bibliography is appended to the article.

Mader, A. Encephalographic experiences in infancy. *Med. Klin., Berl. & Wien,* 1923, xix, 1427–1428.

Encephalography in infancy deals principally with congenital or symptomatic hydrocephalus internus or externus. The method was used in a large number of infants and precocious births. During the first four weeks, and where there is excessive underweight this procedure cannot be employed. On the whole, unpleasant results need not be feared. Thirty c.c., or where the spinal fluid pressure was very high, 40 c.c. of fluid, was evacuated. An equal volume of air was insufflated. It is very important to control the insufflated air by precise pressure regulation, especially when as much as 60 c.c. are used. In the resulting roentgenogram the differences in size of the ventricles are well demonstrable. The ascent of the air into the spaces containing the spinal fluid may be kept under control by observing the tension in the fontanelle. In a series of 20 infants, one death occurred in a moribund, prematurely born child. In some instances, asphyxia was seen. No appreciable difficulties are encountered in the reading of the roentgenogram when the ventricles are dilated on all sides. In one case, encephalographic diagnosis of porencephaly was confirmed by autopsy.

McMahon, F. B. Linitis plastica. *Wisconsin M. J., Milwaukee,* December, 1923, xxii, 296–300.

From a careful special microscopic study of a fairly large number of cases, MacCarty was the first to prove that linitis plastica is a type of gastric malignancy. It appears to be an atypical form of gastric carcinoma with pronounced connective tissue proliferation. Lues does not play an etiological rôle, though the gross pathological picture resembles it closely.

Of 61 cases observed by Lyle, 41 occurred between the ages of thirty and sixty, and among twice as many males as females.

The process shades gradually into normal stomach tissue, but stops abruptly at the pyloric ring. The tissue is rigid, hard and of uniform density and consistency. The wall is thickened, with corresponding loss of lumen. Roentgenographic examination of the barium-filled stomach will usually show a filling defect shading into the uninvolved portion of the stomach, and canalization. There is some dilatation of the stomach proximal to the obstruction.

Miescher, G. Roentgen reaction of the skin, a rhythmic phenomenon? *Klin. Wchnschr.,* 1923, ii, 1932–1933.

It has been shown that the distinction of early roentgen reaction and reaction proper is not exactly correct. The response to roentgen rays occurs in relays (roentgen waves), 2 to 4, generally 3. A genuine inflammatory process corresponds to each wave. Even the first wave, the early reaction, is not an angioneurotic phenomenon. Histologic signs of inflammation will always be found. The individual waves show neither clinical nor histological differences. Probably this pulsating type of roentgen reaction is based upon rhythmic processes occurring in the skin (cellular parthenogenesis).

Palugyay, J. Roentgenographic study of the functional behavior of the esophagus and stomach after esophagogastric anastomosis by Heyrovsky's method. *Arch. f. Klin. Chir., Berl.*, 1923, cxxv, 554–560.

If an operation becomes necessary in the region of the cardia from ulcerative scars or other organic changes, and if a new communication has to be made between the esophagus and the stomach, Heyrovsky's operation is indicated. It yields satisfactory results. According to Finsterer, however, this method is said to have the disadvantage of permitting regurgitation through the anastomosis when the stomach is too full, or in the horizontal position. The author shows that this complication is rare where no previous atony of the esophagus has existed.

This regurgitation was not seen in a patient operated upon by this method, even when the hydrostatic pressure was negative. This can hardly be explained on the ground of mechanical hindrances, therefore the author presumes that the food is regurgitated into the esophagus, but that it is immediately recalled by the esophageal peristalsis, and conveyed into the stomach.

Petersen, O. H. Hemarthrosis in relation to deforming joint affections. *Arch. f. klin. Chir., Berl.*, 1923, cxxvi, 456–472.

Thorough roentgenological examinations of the joints of hemophilics have so far not been made. They would, however, be of great value. Petersen has examined 4 patients of this type, 3 of whom showed changes in the hip joint. The pathological findings were made not only in the articular cartilage and its surrounding tissues, but also in the head of the bone and the epiphyseal line. In one of the cases the entire head of the bone showed extended destruction as far as the epiphyseal line. An examination 10 years later showed mushroom-shape of the head of the bone. The outlines were irregular in the head and in the socket, and circular light spots were seen in the head. In a boy, aged 11, the shadows in the neck of the tumor were irregular; the head was flattened, and partly thickened, and at the upper border it was narrow and broken up. The third case was that of a man, aged 26, where band-like shadows appeared in the right hip outside of the bone. These findings led the author to believe that the views of König were correct, that this disease is caused by hemorrhage in the synovial sac. The writer thinks that hemorrhages occur into the bony substance. There may be two types of bleeding joint, one in which the hemorrhage occurs in the joint, and one where it occurs mainly in the bone. The differential diagnosis from tuberculous diseases of the joint stresses a more prominent change in the roentgenogram with fair functional preservation of the joint. In this differential diagnosis, osteochondritis deformans juvenilis must be taken into consideration. The clinical and roentgen pictures were alike. In order to study this disease more fully, serial roentgenograms should be made.

Reich, L. Roentgen diagnosis of diaphragmatic hernia and allied pathologic pictures of the diaphragm. *Wien. Arch. f. inn. Med.*, 1923, vi, 445–486.

The Müller method for testing the diaphragmatic function is ideal. The normal diaphragm moves upward, downward, or remains immobile. The weaker diaphragm shows greater excursions. The diseased part moves upward more markedly than the healthy parts. The doubly arched line is said to be a proof of diaphragmatic eventration; the author, however, considers it an insignificant sign, and not dependable. Furthermore, the hypothesis that rapid change of the situation of the displaced entrails, and upward movement, is a proof for the non-existence of a hernia, is not tenable. Inasmuch as the contrast meal gives much more valuable information the gastric tube should not be employed. Irritation of the phrenic nerve by farradic current is of no diagnostic aid in the differentiation between eventration and hernia. Pneumoperitoneum is recommended. This method however fails where firm adhesions exist, because in these instances the intestines and the diaphragm are not shown up separately. Measurement of the gastric pressure is not dependable.

Diaphragmatic hernia can be diagnosed definitely only where the Müller test is positive, where the diaphragm or the hernial sac beneath the displaced abdominal viscera can be clearly demonstrated, or where the diaphragm shows a constant circumscribed bulging. Relaxatio diaphragmatica can be diagnosed where the Müller test is positive, where the picture is characteristic in pneumoperitoneum or where the so-called symptom of presentation of the lateral gastric wall is present. If these signs are lacking only a tentative diagnosis can be made. As there are many intermediate conditions the diagnosis cannot always be made with surety.

Schall, W. E. The stimulating and paralysing effect of *x*-rays. *Arch. Radiol. & Electroth., Lond.*, September, 1923, xxviii, 124–125.

Hoffman is quoted from *Strahlentherapie* as saying that upon irradiation of one of the tibias of a growing rabbit with 10 to 20 per cent of the erythema dose there was an increased growth on the side irradiated. This increase never amounted to more than 8 to 10 per cent as compared with the unexposed tibia. Microscopic examinations showed marked differences. After 5 per cent of the erythema dose no stimulating effect was noticed, while with 25 per cent of the erythema dose there was a paralysing effect. This effect was only temporary, and after some months the unexposed tibiæ had reached the same length as the exposed ones. The lethal dose for cells of the bones is more than 300 per cent of the erythema dose.

Jüngling states that beans, *Vicia faba*, exposed to roentgen ray grow more rapidly than those not exposed. Schwarz and Czepa state that these experiments are too few in number, errors are sure to arise and that much experimentation should be done with plants before conclusions are drawn.

SCHLOFFER, H. Introduction of air into all serous spaces, in case of fracture at the base of the skull. *Arch. f. klin. Chir., Berl.*, 1923, cxxvii, 731–744.

This was a case of spontaneous pneumocephalus. The roentgen examination made on the second day after the accident showed no injury to the bones, but almost complete filling of the lateral ventricles with air. The anterior, lower and posterior horns and part of the third ventricle were shown. In the vertex was another accumulation of air, and smaller light spots in the occipital and parietal regions. The same condition was observed on the third and fourth days. Two weeks after the accident the air had disappeared. The roentgenogram of the petrous portion of the left temporal bone indicated that probably a fissure of the left temporal bone existed. The patient was dismissed on the eighteenth day, in good general state of health.

The cases so far published relate to pneumocephalus in connection with extensive skull destruction at its convexity, and where the exterior air has penetrated the ventricle directly. In the case under discussion the air had penetrated from the tympanic cavity. Thence it was admitted through the fracture into the skull cavity, and was absorbed by the basal cisterns.

SCHWARZ, E. On treatment of genital tuberculosis in males and chronic nonspecific epididymitis. *Arch. f. klin. Chir., Berl.*, 1923, cxxvii, 474–492.

Many difficulties in diagnosis of pathological conditions of the testicle exist. It is difficult to differentiate between tuberculosis and nonspecific epididymitis. In the latter case swelling, nodular hardening and pain develop gradually, as they do in tuberculosis.

Some of the 89 cases of bilateral tuberculous epididymitis observed by the author were treated with roentgen rays only. Half or a third of the erythema dose was given every 3 weeks with a filter of 3 mm. In some of the cases the nodular thickening of the epididymis diminished in extent, and in two the fistulæ closed, at least temporarily. Two cases were clinically entirely cured. After operation the roentgen treatment also seems to hasten the healing process. In tuberculosis of the seminal vesicles and of the prostate roentgen treatment should be tried.

STALEY, JOHN C. Gastro-intestinal motility. *Minn. Med.*, January, 1924, vii, 30–34.

In this article particular attention is given to stomach motility, and to control of the pyloric sphincter. The wall of the stomach is composed of 3 layers of muscular tissue covered by peritoneum, and lined with submucosa and mucosa. The outer muscular layer is longitudinal, the middle circular and the inner oblique. The circular layer terminates on the right as the pyloric sphincter, the inner fibers are U-shaped bundles looping the stomach immediately to the left of the cardia. The uppermost fibers are vertically downward on the whole length of the body of the stomach both anterior and posterior. The contraction of this muscle forms a canal underlying the lesser curvature and is seen only when liquids and soft foods are taken. In the adult all anatomical trace of this is lost yet the area functions in many cases as a canal. The plexus of Auerbach lies between the longitudinal and circular coats of muscle. The function of this plexus is to insure the orderly progression of the contents of the gastro-intestinal canal. The reflex here is called the "law of the intestine."

The principal fact is that the gastro-intestinal muscles will contract rhythmically after all extrinsic nerves have been severed and after Auerbach's plexus has been paralyzed by cocaine or nicotine.

In their pyloric sphincter experiments, McClure, Reynolds and Schwartz, found that; (1) neither acid nor alkali in any part of the duodenum, affects the opening or closing of the pyloric ring after a barium meal, as viewed through the fluoroscope, (2) differential discharge of food through the pylorus in man does not obtain as it was found that barium meals of carbohydrates, proteids and fats are alike as to time of beginning evacuation through the pylorus. There is a relationship between the gastric peristaltic waves and the opening and closing of the pyloric ring. When a peristaltic wave passes down on the stomach the pyloric ring is open for the escape of stomach contents; on arrival of the wave at the ring it closes and remains so until the approach of another wave. Carbohydrates pass out in about 3 hours, fats and proteids in about 6 hours. Hunger contractions differ from peristaltic waves in that they begin high up on the cardia; while peristaltic waves begin just above the pyloric portion. Alvarez believes the pace-making region for the stomach is high up on the lesser curvature where the greatest irritability, as well as the highest rate of rhythmic contraction has been noted.

Strauss, O. Radiation therapy in Basedow's disease. *Med. Klin., Berl. & Wien*, 1923, xix, 1372–1377.

In radiation therapy the question as to whether other endocrine glands, aside from the thyroid, play a primary or secondary part in Basedow's disease, is of great importance, but this question cannot yet be answered. Therefore the roentgenologist continues critical investigation. The mortality from operations is overestimated; it does not exceed 3 to 4 per cent. The results from surgical treatment are on the whole favorable. Therefore the advantages and disadvantages of roentgen therapy must be clearly stated. Generally 20 per cent of the cases must be considered as refractory to roentgen treatment. It seems that in the northern countries the results are more favorable than in Germany. A part of the ovarian cases, which were refractory to roentgen therapy yielded favorable results, while part of them were unfavorable. Furthermore, the question as to the existence of a thymogenous Basedow has not been answered. It is however advisable to radiate the thymus in every case where the thyroid gland is radiated.

The thickening of the thyroid capsule, if it follows roentgen treatment, must be considered a serious contraindication. On the other hand, no proof seems to have been given for the causative significance of roentgen therapy in myxedema formation, for a combination of myxedema and Basedow's disease is not rare. Lasting cures cannot yet be estimated, because of the small number so far reported. The fact that roentgen treatment may prove effective after operation has failed is of importance. The author is of the opinion that radiation should be tried in every beginning case, but that operation should not be delayed too long. If a certain risk is involved in the operation, radiation should always be tried. The author recommends the pre-operative radiation in thymogenous Basedow cases. In spite of his good results with radiation he considers operation the approved therapy.

Vigi, F., and Gamberini, M. Aberrant pancreatic tissue in a diverticulum of the stomach. *Riforma med.*, 1924, xl, I.

Aberrant pancreatic tissue is often found in the digestive tract at autopsy. Kremer, among 476 autopsies, made in the Pathological Anatomical Institute of Liege, found aberrant pancreatic tissue 5 times, in the jejunum, ileum and duodenum; Mouchot, among 200 autopsies, 5 times, 4 in the duodenum and 1 in the jejunum. Askanazy, when performing a necropsy on a child, aged two, who had died of bronchopneumonia, found a small accessory pancreas in the region of the pylorus. He reports other cases where the aberrant tissue assumed different forms.

The writer states that if a roentgenogram of the stomach had been made in these cases a small niche would have been found, similar to that found where small ulcers exist near the pylorus. In this manner particles of pancreatic tissue may also be discovered.

Watson, Charles M. Diverticula of jejunum. A case with enterolith causing intestinal obstruction. *Surg., Gynec. & Obst., Chicago*, January, 1924, xxxviii, 67–71.

Sir Astley Cooper, in 1844, reported a necropsy showing diverticula of the jejunum. Since then 25 additional cases have been collected, nearly all at necropsy. A case is reported in which an enterolith in a diverticulum of the jejunum was causing obstruction by the angulation which its traction and weight produced. Barium-meal diagnosis of organic lesion of the sigmoid was made, but operative procedure showed the enterolith; the patient made a good recovery. A short report of each of 24 cases is given; 18 cases were found post mortem; in 8 operative cases 2 were unrelated to the symptoms for which the abdomen was opened; in 2 instances the diagnosis was made by the roentgen ray and demonstrated by operation. Of the reports giving the sex, 19 cases were given as occurring in the male, and 9 in the female.

A bibliography of twenty-four references is given.

Zbinden, Theodore. The action of radium upon cancer of the cervix. *Ohio State M. J., Columbus*, January, 1924, xx, 14–16.

Histology has given a wealth of detail more or less extraneous, yet of great value in the practical use of radium, such as the depth of penetration of radium rays, length of time required to kill cancer cells, the selective action on neoplastic as compared with normal tissue and the variable response to irradiation by tumors according to their histological structure. Frankl found, about 3 days after treatment, an edematous swelling of the cancer cell with loss of structural detail, 2 or 3 days later the swollen chromatin threads of the nucleus broke up into coarse, deeply staining fragments and e[illegible] broke through the nuclear membrane into the cytoplasm, the chromatin was liquefied and lost its characteristic staining qualities, the liquid portions disappeared from the cell, its outlines were lost, and only a finely granular, necrotic mass remained. This required about 2 weeks and occurred within a radius of 2 cm. from the radium tube. Further changes took place for an additional period of from 4 to 6 weeks, due to local and general tissue reaction. Polynuclear leucocytes increase; their enzymes further dissolve and favor removal of necrotic tumor masses. Soon fibroblastic proliferation of the stroma occurs and ultimately the tumor is replaced by a dense, highly cellular fibrous tissue. The arterioles of the stroma when not too severely injured show a swelling of the endothelial lining and an edematous condition of the wall. Later, round cells infiltrate this wall, leading to a fibrosis with narrowing of the lumen and a disappearance of the unstriped muscle. This process continues and the fibrous tissue of the stroma contracts more and more, the cells are crowded out and the blood supply more and more shut off. Almost a full year is required to complete the process.

Deneke, Th. The aorta in the roentgenogram. *Deutsche med. Wchnschr., Berl. & Leipz.*, March 7, 1924, l, 293–296.

The apparent width of the aorta in its visible portion, when viewed laterally, gives no indication whatever of the width of the valve ring. Because it is hidden in the heart shadow, the first portion of the aorta may have extensive pathological change (syphilis, etc.) without being detected in the roentgenogram.

Of great value is the view (first angular view) from right front through left back at an angle varying from 45° to 80° from the lateral. The Frik method of raising the left scapula from the field is an important aid. The ascending and descending aorta becomes visible, as well as the retrovasal and retrocardial spaces. More important still, is the view (second angular view) from left front to right back at an angle perpendicular to the plane of the aortic arch. This reveals the width of the ascending aorta; but actual measurements are difficult and all methods to date are not free from criticism.

Aortic sclerosis in the first stage is visible as a lengthening of the aorta together with intensification of its shadow. The second stage appears as a uniform, cylindrical or flat spindle-shaped widening. Non-syphilitic bulbous dilatations are rather rare. The differentiation between arteriosclerosis and syphilitic aortitis is not easy. Usually aortic dilatation with medium depth of shadow, especially if in a person of middle age, rather indicates syphilis.

The roentgenogram is particularly characteristic in the case of aneurysms. The local swelling of the aorta may or may not show pulsation, but from whatever angle viewed, the swelling must never show separation from the aortic shadow. The differentiation of aneurysms from tumors is often difficult.

Engels, Herm. Roentgenologic aspects of tuberculosis. *München. med. Wchnschr.*, March 7, 1924, lxxi, 289–291.

The author presents 32 roentgenograms to illustrate the results he obtained in treatment of tuberculosis (pulmonary, bone and joint) with the Friedmann tuberculosis vaccine. The object sought in the treatment was to transform the tuberculosis from the exudative type to the proliferative. The pictures show intensification of the shadows, which is interpreted as the desired change produced by the Friedmann treatment.

Ewald, G. Fractional castration by roentgen rays and operation in a menstrually recurring psychosis. *München. med. Wchnschr.*, March 14, 1924, lxxi, 336–338.

The patient, a woman aged 50, had a psychosis of the manic-melancholic type. Periods of stupor occurred rather frequently during the menstrual period. Roentgen-ray treatment of the ovaries resulted in cessation of the menstruation; but the periodic stupors recurred. Further irradiation of the interstitial gland and remains of the follicular apparatus gave no improvement, and finally surgical removal of the whole genital system was resorted to. The periodic stupors recurred as before. The author believes that this periodicity in the female is related to her entire biological structure, and not exclusively to the pelvic genital organs.

Freund, Leopold. Roentgen diagnosis and roentgen therapy of lymphogranulomatosis. *Wien. klin. Wchnschr.*, March 6, 1924, xxxvii, 239–241.

The case described in detail is of especial interest because of the severe osseous changes which were demonstrated roentgenographically. This is the second case reported in the literature in which involvement of the bone was clearly demonstrated by roentgen examination.

At first, roentgenotherapy caused decided recession in the symptoms, but as time progressed the treatment was not so effective. It was observed that the glandular tumors remained sensitive to the roentgen rays, but the bone involvement gradually lost its sensitiveness to the roentgen rays.

Geller, Fr. Chr. The effect of roentgen rays on young organisms. *Klin. Wchnschr.*, April 1, 1924, iii, 561–566.

Roentgen rays act upon young animals, locally and generally, in an accelerating or inhibitory manner. The effect is dependent upon (a) the radiation dosage; (b) the age of the animals; (c) the site of application; and (d) external and internal biological conditions. Since the effect upon the animal is dependent upon so many various conditions which are not thoroughly understood, it is impossible to speak of absolute doses corresponding to certain effects. The duration of stimulation or inhibition by roentgen rays on animals is an unknown subject.

Experiments are reported upon the effects of radiation in rabbits. In young, sexually immature rabbits 11 to 15 weeks old, mild roentgen radiation of the ovaries (20 to 30 per cent erythema dose) stimulates the development of the uterus and the increase in weight, but stunts the length. Radiation of small intensity of the uterus stimulates its development but appears to have no marked effect upon the general development. A still milder radiation of the ovaries (10 per cent erythema dose) has no stimulating effect on the weight or length of the animal. Stronger radiation (50 per cent erythema dose) of the ovary inhibits the increase of both weight and length.

Glaser, Kurt. Severe colitis following roentgen irradiation. *Deutsche med. Wchnschr., Berl. & Leipz.*, February 22, 1924, l, 243.

A woman with metrorrhagia was advised roentgen-ray treatment by the gynecologist. An acute colitis followed the fourth treatment, and developed into a chronic ulcerating colitis of the rectum and colon. This is another example of the high susceptibility to roentgen-ray damage of the intestinal glands in certain individuals. The cause is obscure.

Gutzeit, K., Brinkmann, J., and Kötschau, K. The stimulating effect of roentgen rays with experimental studies on microorganisms. *München. med. Wchnschr.*, February 8, 1924, lxxi, 162–165.

Preliminary experiments upon typhoid, paratyphoid and pyocyaneous bacilli exposed to roentgen rays at distances of 30 to 215 cm. showed a remarkable increase in their motility. Yeast cells similarly treated showed no change in their CO_2-production. Numerous experiments with colon bacilli showed that exposure to roentgen rays caused an increased acid production by the organisms. Similar results were obtained with the diphtheria bacillus. Dosage of roentgen rays favoring optimal acid production by the organisms corresponds to 6 to 10 per cent of the skin erythema dose. The colon bacilli appear to have a wider zone of tolerance for roentgen rays than do the diphtheria bacilli. Freshly isolated cultures and old laboratory strains behave alike.

These observations conform to the general biological fact that sufficiently small doses stimulate the living cells; while inhibitive effects are due to exposures beyond the threshold values.

Hahn, Ludwig. The question of space dosage in deep roentgenotherapy. *München. med. Wchnschr.*, March 21, 1924, lxxi, 371.

Objection is raised to the primary assumption of Jüngling in his estimation of the radiation absorbed by the body. His method leaves out of account that proportion of the radiation entering the body, which, instead of going directly inward is deflected in all directions. Hahn states that this must be measured directly on the phantom. The incoming radiation is measured per unit of surface and the outgoing likewise measured for different depths. In other words, the values for absorption of radiation cannot be calculated by the simple formula suggested by Jüngling.

Händel, Marcel, and Tadenuma, Kenji. The metabolism of carcinomatous rats as influenced by roentgen radiation of the tumor. *Deutsche med. Wchnschr., Berl. & Leipz.*, February, 29, 1924, l, 271.

Carcinomatous animals, especially those with large tumors, have a lower metabolism than the normal. Following deep irradiation of the tumors, there was observed an increase in the metabolism of the animal. This is explained as probably due to injury of the vital activities of the tumor with consequent diminution of the cancerous toxins which are held responsible for impairment of the oxidative activities of normal tissues.

Hass, Julius. Roentgen treatment of bone and joint tuberculosis. *Wien. klin Wchnschr.*, May 1, 1924, xxxvii, 435–436.

The author claims to be the first to have successfully applied roentgen therapy to tuberculosis of the larger joints such as those of the knee and hip. One of the effects of the treatment is an acceleration in formation of scar and granulation tissue. There also seems to be an improvement in the general defense reaction of the body. The effect seems to depend not upon the hardness of the rays but rather upon the total amount absorbed by the tissues.

As to the dosage, it is concluded that there is no such thing as a "tuberculosis dose" for the reason that each case has its own peculiarities. Clinical experience seems to be the only reliable guide. One point emphasized is to beware of excessive dosage. Treatment is begun with 3 units (the threshold dose of Holzknecht) and is gradually increased to the point where a clinical effect such as increase in temperature, etc., first becomes evident. The last is considered the maximal dose and should never be exceeded. In adults the treatment as a rule consisted of 5 units filtered through 4 mm. Al., and repeated at intervals of 6 weeks until cured. In children the dosage is ½ to ⅔ that of adults.

Early cases in the acute stage are entirely unsuited to roentgenotherapy. The treatment is indicated in those cases where the acute symptoms have passed and the general condition has been improved. Roentgen treatment in advanced cases with complete caseation and in cachexia is contraindicated.

The prognosis is usually favorable. It is very good in the case of the small joints; and in the larger joints recovery though slower is definite, provided treatment is continued. Emphasis is laid upon combination of the roentgen treatment with the customary surgical and orthopedic measures which are so necessary in the proper treatment of these conditions.

Holzknecht, G. Thyroid carcinoma and roentgen treatment. *Wien. klin. Wchnschr.*, April 24, 1924, xxxvii, 419–420.

The author's experience conforms with that of Perthes in respect to the treatment of carcinoma of the thyroid. This is one condition in which total extirpation by surgery is contraindicated. Of course this does not preclude removal of portions of the gland. Cases of thyroid carcinoma in which life was prolonged up to 7 years by roentgen-ray treatment have occurred in the experience of several observers.

Holzknecht, G. Variations in radiosensitivity of cells and the periodic application of roentgen rays. *Wien. klin. Wchnschr.*, February 21, 1924, xxxvii, 194–195.

It is true that G. Schwarz suggested long ago the intermittent application of roentgen rays as a therapeutic measure. This suggestion was neglected until recent writers demonstrated the periodic recurrence of radiosensitivity in the multiplying cell mass. The real credit for this mode of roentgenotherapy seems therefore to be due to the recent workers who furnished the experimental foundation for the procedure.

Schwarz replies to this criticism by citing quotations from his original article in 1914 in which he pointed out the variation in sensitivity of cells during their life cycle.

Jarre, Hans. Breast carcinoma, its early radiation and surgical treatment. *Klin. Wchnschr.*, April 1, 1924, iii, 584–587.

In early cases a pretreatment with radium or roentgen rays is recommended. Operation should be performed within 10 days after radiation because wound healing occurs without difficulty. Operation should not be performed in the 3d, 8th or 12th week following radiation because wound healing is very poor. The author believes that in early cases removal of the axillary glands is not necessary, provided the tumor has received adequate radiation. With good technique of administration of radiation there is no danger of pulmonary complications. The thing to be avoided is overdosage.

In advanced cases radical irradiation is necessary followed by radical operation with removal of all involved tissue and thorough after-radiation. In inoperable cases repeated radiations in medium doses, extended over a long time are recommended. Radical radiation is to be avoided. Pharmacology and immunotherapy have as yet nothing hopeful to offer in such conditions.

Jüngling, Otto. The problem of space dosage in deep roentgenotherapy. *München. med. Wchnschr.*, February 1, 1924, lxxi, 123–125.

The space dose is defined as the total roentgen-ray energy absorbed in irradiation. For purposes of standardization the relatively small amount of dispersion and diffusion may be neglected. The rays are filtered through a heavy metal screen so that their character remains essentially unaltered by further passage through water or body tissues. The per cent absorption of such rays in water may be determined by means of the electroscope. In this manner the depth of penetration may be calculated. For instance, if 15 per cent of the rays are absorbed per centimeter thickness of water, then the total depth of penetration is about 20 cm. By means of such a calculation a table may be constructed for any given set of conditions showing the percentage of absorption of radiation to any depth.

Roentgen radiation completely absorbed in a depth of 20 cm. from an area of 1 sq. cm. receiving 100 per cent of a skin erythema dose (and filtered through a heavy metal screen) is defined by the writer as 100 units of intensity.

This unit may be imagined as a right-angled prism 20 cm. high and 1 sq. cm. in cross section. If the field exposed is larger, the number of units is multiplied by the area. If the skin dose is less than the erythema dose then the unit dose is multiplied by the fraction of the erythema dose given. If the depth of the rays is less than 20 cm. the number of units may be read off from the table constructed as above. Attention is directed to the possible utility of determining the relative space dose per kilogram of body weight in the case of children.

Kok, Friedrich. Further animal experiments on the effects of roentgen rays on carcinoma. *Deutsche med. Wchnschr., Berl. & Leipz.*, March 7, 1924, l, 298.

Mice were irradiated shortly before, or within 3 days after inoculation with a virulent strain of transplantable carcinoma. It was found that regression was much slower after direct irradiation of the inoculation site than when a larger portion of adjacent body surface was also exposed. Doses of 315 mouse units were not nearly so effective as 225 or even 100 units. Irradiation of the whole animal gave better results than local exposure—25 mouse units (10 per cent of the epilation dose) being ample for protection.

Krutzsch, G. A case of cysticercus cellulosae diagnosed roentgenographically during life. *München. med. Wchnschr.*, February 1, 1924, lxxi, 137.

The patient was a butcher with a history of tapeworm infestation. Roentgen examination disclosed numerous calcified cysts in the neck, shoulder, arm and thoracic musculature. The shadows were dense, lens-shaped and disposed in the direction of the muscle fascies. Other clinical data confirmed the diagnosis.

Kurtzahn. The radiation treatment of tumors in surgery. *Deutsche med. Wchnschr., Berl. & Leipz.*, March 28, 1924, l, 394–396.

Many tumors remain unaffected unless given intensive roentgen-ray treatment. Carcinomas should receive 95 to 110 per cent of the skin unit dose. Variation in radio-sensitivity is greater in sarcomas than in carcinomas. The sensitiveness decreases in lymphosarcoma, round-cell and spindle-cell and chondrosarcomas in the order named. Melanosarcomas are usually refractory. The usual sarcoma dose is 70 per cent of the skin unit. The matter of homogeneous irradiation is a difficult problem in which only slight progress has been recorded.

Brass-filtered radium radiation of tumors does not penetrate more than 2.5 cm. In large tumors, radium is useful only in conjunction with roentgen rays. In carcinoma of the lip and tongue, radium is effective while roentgen rays are not. Radium dosage is determined empirically for man from the erythema dose in the dog.

There is no proof that the average survival of persons with cancer is much greater in irradiated cases than in those not thus treated. Experience shows that operable tumors should not be radiated. For inoperable tumors, radiation seems to be the only hope at present.

Lewin, Hans. A film-holder belt for roentgenograms. *Deutsche med. Wchnschr., Berl. & Leipz.*, March 14, 1924, l, 341.

The object of the device is to permit taking frequent roentgenograms of small abdominal areas. It has a metallic frame so that the desired roentgen field may be selected, and the device then fixed in position by means of straps. Photographic plates, film-packs or roll films can be used in the holder.

Pordes, Fritz. The action of roentgen rays and the structure of matter. *Wien. klin. Wchnschr.*, February 21, 1924, xxxvii, 192–194.

The primary effect of roentgen rays is the detachment of electrons in the radiated cells. Certain cells like the lymphocytes are less resistant than others to this micro-bombardment. The end-result is an effect upon the colloidal system constituting the cells and upon their biochemical equilibrium.

Sahler, Josef. Therapeutic results of spleen irradiation in gynecological hemorrhage. *Wien. klin. Wchnschr.*, April 17, 1924, xxxvii, 392–394.

It has been observed that irradiation of the spleen has no effect in preventing hemorrhage in connection with placenta praevia. Polymenorrhea can nearly always be controlled by such treatment; but hypermenorrhea or polyhypermenorrhea was controlled in but 50 per cent of the cases.

In a total of 143 cases of the 3 types last mentioned, an immediate successful result was obtained in 71 per cent. The permanent results, however, were poor. Of 135 cases recorded, only 26 per cent recovered, and 34 per cent were doubtful. The obvious utility of spleen radiation is therefore mainly in effecting immediate control of a profuse hemorrhage.

One technique used was as follows: 2 ma., 23 cm. skin distance, 6 × 8 cm. field, 0.5 mm. zinc and 4 mm. Al. filter, ⅓ erythema dose; this being repeated in 3 or 4 days with ⅔ erythema dose. The other method was: 2 ma., 40 cm. distance, 10 × 15 cm. field, 0.5 mm. zinc and 4 mm. Al. filter, ⅓ to ⅔ erythema dose. No notable difference was observed between these two methods of application.

inflammation; it is therefore especially valuable about the face. Many roentgen-ray workers develop a keratosis which may become epitheliomatous. Endothermy shows a high percentage of apparent cure with splendid cosmetic results.

For the removal of deep-seated malignant disease, bipolar endothermy is employed but with these more powerful currents anesthesia is needed. The D'Arsonval current of low voltage and high amperage coagulates the tissues. Before the malignant growth is touched it is completely surrounded by a wall of coagulation necrosis which isolates the growth and shuts off the blood vessels and lymphatics about the effected part. A specimen for section can then be taken, after which the malignant area is destroyed *in situ*. The wall of necrosis in the healthy tissue also cuts off sensory nerves bringing about prompt alleviation of pain, one of the remarkable features of treatment by endothermy. When the work is properly done, there is no hemorrhage following the removal of the destroyed tissue.

In tumors of the bladder, the writer removes through the cystoscope only small papillomas, where the entire base can be seen. In all other conditions, a hypogastric incision is made; an electric light in the bladder is used to bring the lesion in full view, and the tumor is destroyed and removed at its base, the technique of monopolar endothermy often being the method of choice.

Clifford, Randall, and Ritvo, Max. The value of the *x*-ray in pulmonary diagnosis. *Boston M. & S. J.*, May 15, 1924, cxc, 833–837.

Four groups of cases are encountered. The first and largest group comprises cases in which clinical and roentgen findings are in agreement. These include early pneumonia in children, foreign body, encapsulated fluid and deep abscess. The roentgen findings often show the extent, location and progress of the disease.

Group 2 represents rather rare cases with definite diagnosis based upon history and physical findings, but where the roentgen findings were negative, indefinite or misleading. A case of bronchiectasis is cited as illustration.

Group 3 includes cases with absent or insufficient clinical findings, and in which diagnosis was based on roentgen evidence alone. In a case of liver carcinoma with pulmonary metastases, there was extensive lung involvement as revealed by the roentgenogram, but there were no definite clinical signs. A case of breast carcinoma with extensive metastases is also cited.

Group 4 includes cases in which clinical findings led to incorrect diagnosis, while the roentgenogram gave the correct one. In one case, a diagnosis of pulmonary tuberculosis was made clinically, and the roentgen examination revealed Hodgkin's disease. In another case, a clinical pulmonary tuberculosis was found on roentgen examination to be pulmonary metastasis of spermatozoal carcinoma.

Culligan, John M. Renal stones permeable to the *x*-ray. *Radiology*, June, 1924, ii, 411–413.

In the case reported, a large uric acid stone in the pelvis of the kidney failed to give a roentgen-ray shadow. A pyelograph showed a lighter area at the site of the calculus. Shadowless renal stones are usually composed of pure cystine, xanthine or uric acid. Such stones may produce roentgen shadows when admixed with other salts. Shadowless stones usually remain invisible even when the kidney is roentgenoscoped after delivery through the incision. This circumstance may make it advisable to nephrectomize when doubt exists as to whether fragments of the stone are left behind.

Davis, Kenneth S. The history of radium. *Radiology*, May, 1924, ii, 334–342.

A brief history is given of the discovery and methods of extraction of radium, the utilization of its physical and chemical properties and the first treatment of various diseases with radium from 1902 to 1909. A letter written in 1903 by Alexander Graham Bell is quoted, in which is contained the first suggestion to apply radium to the interior of tumors by means of fine hollow tubes.

Hanks, Mary Elizabeth. The roentgen ray as a remedy in fibromyomata and other benign gynecologic diseases: a review of 222 cases. *Radiology*, May, 1924, ii, 317–325.

The technique used was: spark-gap, 23 cm.; distance, 18 to 43 cm.; 5 ma., 3 to 5 mm. Al. and sole leather; exposure time, 5 to 17 min. through as many ports of entry, 8 to 13 cm. diameter, as were required by the condition. Technique and number of treatments varied according to the individual requirements.

In the radiated fibromyoma, the cell nuclei are first obliterated, then the entire cell disintegrates and the leucocytes carry off the detritus. With small serial doses, this is done smoothly and often completely. Contra-indications for roentgen-ray treatment of these tumors are: Tumor associated with acute symptoms; tumor associated with large ovarian tumors; pedunculated tumors with slender pedicle in danger of torsion; concurrent gonococcus infection; suspicion of malignancy; submucous tumors; large non-vascular tumors. Hemorrhagic intramural tumors yield most readily to roentgen treatment, and fortunately about 75 per cent of all cases fall in this group.

The survey shows that in a total of 160 finished cases, 75 per cent show no demonstrable tumor, and 10 per cent are free from all symptoms (tumors reduced) and clinically cured. Roentgen radiation remedies the precancerous state and may even arrest undetected incipient cancer. Sarcomatous transformation of myomas is a negligible risk. In many cases roentgen therapy is preferable to radium.

Harbinson, Charles H. The effects of roentgen-ray energy on the spleen. *Am. J. M. Sc., Phila.*, April, 1924, clxvii, 529–541.

The shaven lower abdomen or exposed spleen of rabbits was irradiated for 15 minutes, tube-target distance 11.5 inches, 50 ma., 50 kv., with 5-inch spark gap. This lethal dose of rays produced systemic intoxication ending in death on the 11th day after irradiation of the lower abdomen or left hypochondrium. On the other hand, direct raying of the spleen with the same dose caused no apparent clinical symptoms. There was a temporary leucopenia followed by a relative lymphocytosis and a return to normal. Increased erythrocyte destruction was evidenced by low red cell counts and increased hemosiderin of liver and spleen.

At autopsy, the pale spleen showed no pathological change other than an early stage of chromatolysis. The liver was large and pale; and sections showed a washed-out appearance of the liver cells, hyperplasia and desquamation of the Kupffer cells and abnormal hemosiderin content.

Harding, Donnan B. Lymphosarcoma of the stomach. *Radiology*, May, 1924, ii, 315–316.

This case in a boy of 16 is reported because of its relative infrequency. Roentgen-ray examination of the stomach disclosed a large filling defect on the greater curvature. This defect, associated with a palpable mass, presented a picture undifferentiable from carcinoma of the stomach. Laparotomy revealed a large tumor which was diagnosed as lymphosarcoma. The postoperative course was uneventful, and the patient died a month later.

Herly, Louis. Present status of intensive, high-voltage radiation therapy of cancer. *J. Radiol.*, March, 1924, v, 71–77.

A brief history is given of the development of radiation therapy. A summary of the present status shows that, (1) a biopsy performed before treatment is harmless, (2) a standard "carcinoma dose" or "sarcoma dose" of roentgen rays cannot be established biologically, (3) roentgen rays do not kill cancer cells directly, (4) there is no unimpeachable proof that insufficient raying stimulates tumor growth.

It would seem that the old roentgen-ray machines commonly used for therapy in America can produce, with increased distance, filtration and time, as good results as the high-voltage apparatus of the Germans. Intensive, high-voltage raying damages normal tissue. Connective tissue damage breaks down the barriers to cancer invasion. Damage to endocrine glands reduces the general resistance of the individual, and by itself may lead to death.

Hubert, Georg. The diagnosis of aortic syphilis with special regard to roentgen diagnosis. *Klin. Wchnschr.*, May 13, 1924, iii, 886–891.

Roentgen diagnosis has greatly improved the recognition and examination of aortic syphilis. This disease produces 3 definite roentgenologic changes, namely, dilatation, abnormal density of shadow, and altered aortic pulsation. Dilatation may be diffuse, but as a rule, the wall of the ascending aorta becomes convexly enlarged. This, together with a normal descending branch is usual in early syphilis and points against arteriosclerosis. Syphilitic aortitis produces an abnormal density which is discernible by the experienced radiologist. In the second oblique diameter, the ascending aorta shows a deeper shadow than the descending in the case of syphilis, and both parts have the same density in sclerosis. Abnormal pulsation of the ascending aorta alone is characteristic of syphilis. In sclerosis, abnormal pulsation is rare and always involves both the ascending and descending aorta.

Küstner, Hans. Standardization of the measurement of roentgen-ray dosage. *Klin. Wchnschr.*, April 29, 1924, iii, 774–777.

There should be an official standard unit of roentgen radiation; and as is the case with the international standard meter, the primary standard should be used for occasional comparison purposes, while secondary portable standards should be available for ordinary everyday uses.

The unit should be preferably in terms of biological action, but this is too variable a factor to be satisfactory. The amount of roentgen-ray energy absorbed might form a basis for standardization, but as yet, appropriate methods have not been perfected to measure rays of different degrees of hardness. The electrostatic unit as measured at 10 atmospheres pressure is a definitely measurable quantity and is designated as "1 roentgen." This unit may be modified by a sensitivity coefficient for each case, depending on the conditions of irradiation,—such as ray hardness, field exposed, duration, skin focal distance, etc.

The Göttingen standard instrument with an ionization chamber of carbon 30 cm. long is suitable as a primary standard. Its constancy was checked with a radium preparation. The hardness of the radiation is determined by filtering it through copper screen of such thickness as to reduce the intensity of the emerging radiation to one-half. This value is called the "average half-value through copper."

Standardization of two different types of dosimeter revealed great variation in their sensitivity to hard and soft rays. The Fürstenau intensimeter exhibited fatigue within the first 40 minutes, its indications dropping about 27 per cent. For longer periods, its indications varied about 10 per cent from the average. The Kienböck quantimeter was found utterly unreliable, in that similarly treated strips showed 89 per cent variation in recorded intensities.

LEOPOLD, SIMON S. Postoperative massive pulmonary collapse and drowned lung. *Am. J. M. Sc., Phila.*, March, 1924, clxvii, 421–433.

Comparative roentgenograms are presented for 4 cases. Displacement of the heart toward the affected side is an essential diagnostic sign. The involved lung shadow is so dense as to completely obscure the rib shadows. Retention of fluids within the collapsed lung probably accounts for the extraordinary roentgen-ray density. Direct bronchoscopy was not done to see if bronchial obstruction existed in these cases; but it is suspected that such obstruction always exists in this condition. The name suggested for the syndrome is that given in the title.

Pulmonary collapse in conditions other than those seen postoperatively is probably pure atelectasis without drowned lung, and has a different cause. It would appear that massive collapse and drowned lung is more common than surveys of postoperative pulmonary complications would indicate.

LIECHTI, ADOLF. Studies on the action of metals as secondary radiators. *Klin. Wchnschr.*, May 6, 1924, iii, 825–828.

Experiments were made on agar plate cultures of *B. prodigiosus*. Irradiation with about 55 per cent skin unit dose through metals of medium atomic number (near 50: Ag, Cd, Sn, Sb), and of high atomic number (near 80: Au and Pb), produced an inhibitory effect equivalent to that of 20 to 25 skin units applied directly. This increase of 40 to 50 times is due to secondary radiation. Both of the above groups of elements showed the same intensity of action when used as the metal or the metal salt.

Filtration experiments on the secondary radiations indicate that they consist mostly of very soft rays. Consideration of the physics of the process suggests that the beta radiation of the metals is the biologically active agent.

LOGAN, A. H. Chronic ulcerative colitis: its clinical and radiological aspects. *Radiology*, May, 1924, ii, 302–304.

The typical roentgen picture in chronic disease shows a narrow non-haustrated colon with loss of redundancy, often with narrow areas of either spasm or stricture. In the upper colon where the inflammation is beginning, irritation may produce many sharp-pointed haustra close together. Tumors may be demonstrated long before clinical signs are diagnostic.

The inflammation starts in the rectum and extends slowly or rapidly throughout the entire rectum. Diagnosis is made from the clinical symptoms, the characteristic stool and the proctoscopic findings. Treatment is very unsatisfactory, remissions with subsequent relapses being the rule, and cure the exception.

MOORE, SHERWOOD. On the incidence of the sacralized transverse process and its significance. *Radiology*, May, 1924, ii, 287–301.

A high incidence of sacralization was found in cases sent for genito-urinary examination, and genito-urinary disease can well exaggerate the symptoms of spinal disturbance. The same can be said for conditions of the lower alimentary tract.

Roentgenographically, the presence of sacralization should be conditioned by the following: (1) the upper and a varying proportion of the outer border of the sacralized process should have the form, outline and dimensions approximately those of a normal 5th process; (2) the sacralized process must be manifest as an increase in size which originates from its inferior surface; (3) this mass of bone must extend downward and outward; (4) a small portion of the root of the process which shows no enlargement must remain, equaling the dimension of the canal for the 5th lumbar nerve. In lumbarization of the 1st sacral vertebra, the lumbarized process should present an upper and varying portion of outer border, having the outline and dimensions comparable to a 5th transverse process. At the same time, the massive bulk of the inferior portion should approach in appearance a sacral ala.

These conditions, which cannot be distinguished with precision, have not been com-

When this tendency is the same for both radiations, their relative physiological effects and ionizing powers were found to be of the same general order.

Characteristics of the relation between roentgen radiation intensity and velocity of physiological reaction suggest that the effects are due to formation of ionization fields in the paths of the secondary radiations.

Robertson, John K. *X*-rays and *x*-ray apparatus: an elementary course. *J. Radiol.*, March, 1924, v, 84–91.

The following subjects are discussed in detail with diagrams. Dosage by ionization; saturation ionization current; the erythema dosa in E. S. units; intensity by the use of an electroscope; electrometers and direct measure of dosage; Salomon's iontometer; deep therapy; dosage in deep therapy; necessity of standardization.

Stenstrom, Wilhelm. Consideration of body dose in radiation therapy. *J. Cancer Research*, April, 1924, viii, 30–33.

The unit for body dose used by the author is designated A_x, and is about 1/100 that of the unit *a* suggested by Wintz. A_x is defined as follows. The roentgen tube is excited by 200 kv., 60 cycle a.c., two-way rectification; and the rays are filtered through 0.5 mm. Cu. and 5 mm. wood. When an erythema dose is given on a 10 × 10 cm. field on the skin, then 100 A_x will be absorbed by the first 5 cm. of tissue, assuming no loss by lateral scattering of rays. The absorption by different layers of body tissue is tabulated below.

Depth	200 kv. 0.5 mm. Cu.	140 kv. 0.25 mm. Cu.
0–5 cm.	100 A_x	95 A_x
5–10	70	60
10–15	50	38
15–20	35	24
20–25	25	15
25–30	18	10
30–35	12	—

Body dose of radium or emanation in uterine applications is equal to 8 to 10 A_x for 100 millicurie hours, depending on the size of the patient. Body dose per pound will give better comparative values. For breast carcinoma, 10 to 15 A_x units per pound are applied. Uterine treatment takes 20 to 30 A_x per pound. Radiation of extremities takes from 1 to 5 A_x per pound.

Stenstrom, Wilhelm. Dosage one and two centimeters under the skin from unfiltered *x*-rays. *J. Cancer Research*, April, 1924, viii, 18–21.

Five circular fields, 2 cm. in diameter, were irradiated on the back of each of 2 patients. In one case the fields were arranged symmetrically in a circle 12 cm. in diameter; and in the other, the fields were arranged in 2 rows.

Sheets of paraffin were used for absorbing and scattering of the rays produced by a Kelley-Koett machine, 90 kv., 10 ma., 23 cm. focus-skin distance. The degree of erythema was estimated from the color produced. It was found that the dose at 1 cm. depth is between 50 and 60 per cent of the skin dose, and at 2 cm. between 25 and 35 per cent.

Stenstrom, Wilhelm, and Mueller, Theodor. A flexible arrangement for the simultaneous radiation of a patient with three tubes. *J. Cancer Research*, April, 1924, viii, 22–29.

Objections to the rigid tube arrangement for deep roentgen therapy are: Unsuitability to special individual needs and the irradiation of too large a volume of the patient's body. Advantages of the flexible arrangement are: Possibility of irradiating from any angle; and ability to select ports of entry for cross-firing which are nearest to the diseased region. Only small skin areas need be exposed for adequate dosage; and at the same time distribution of the rays through the irradiated part is better because they can be made more homogeneous. When 3 fields are directed against each other at 120°, the distribution of rays through the irradiated volume is quite homogeneous. Of course, exact location of the spot to be irradiated is necessary in cross-firing. In general, the flexible tube arrangement requires greater skill, experience and accuracy to operate.

A special stand is described for the flexible arrangement. To shorten the time of roentgen-ray administration, the simultaneous use of two tubes, at skin distances of 70 to 80 cm. has been found satisfactory, since the strain on the patient's endurance is lessened.

Stephenson, F. B. Shift measurements on stereoscopic plates. *Radiology*, May, 1924, ii, 326–329.

A means is suggested for correcting false or doubtful visual impressions. The method is as follows: Given a set of stereoscopic plates select a shadow whose position is known. Taking one plate, measure the distance from one edge to the selected landmark and also to the shadow in question. Do the same thing on the other plate from the corresponding edge. Subtract the figures on one plate from the corresponding ones on the other to obtain the shift of the landmark and of the other shadow. If the landmark has shifted more than the other shadow, then the latter is closer to the plate, and vice versa.

This shadow shift will be the same whether the object is in the path of vertical or oblique rays, and is therefore a correct factor to use in calculating the vertical distance from any object to the plate on the basis of the vertical target-plate distance. Let td = target-plate distance; od = object-plate distance; ts = tube shift; and ss = shadow shift. The formula will then be $od = (ss \times td)$ divided by $(ss + ts)$.

Terrill, H. M., and Pine, Mary. *X*-ray spectra with certain filters. *J. Cancer Research*, April, 1924, viii, 68–74.

The measurement of energy of the short and long wave lengths of roentgen and gamma rays is difficult. The comparison demands that the beams be monochromatic; but as yet reflection crystal spectra do not furnish sufficient energy to affect tissue. Filtration methods yield a little information. The tantalum filter gives a fairly monochromatic radiation and is convenient to handle. Spectra plotted from ionization chamber readings are given for the following filters: Cu., W., Ta., Yb., Th. and Ag. Short wave lengths, being less completely absorbed, show rather low energy levels in the plots. However, it is believed that these short wave lengths are not absorbed by tissues. Just as a Cu. filter gives more energy in short wave lengths than Al., so a metal that scattered less than Cu. would give still greater proportions of energy in the short waves. Silver is such a metal, and is recommended for use with high voltages. This remains to be tested biologically.

Ullmann, H. J. A diagnostic line for determining subluxation of the fifth lumbar vertebra. *Radiology*, May, 1924, ii, 305–306.

Displacements of the 5th lumbar vertebra when fairly marked are recognized either by anteroposterior or lateral roentgenograms; but normal variations are great. It is suggested that a large number of symptomless individuals as well as those with symptoms be observed to determine how far from a sacral base line the 5th lumbar vertebra may be placed and still be within the norm.

The base-line suggested is established as follows. A lateral roentgenogram is taken with the tube centered over the joint or over the 3d or 4th lumbar vertebra. Two points, as far apart as possible, on the edge of the sacral articular surface are connected by a straight line. This is projected until it intersects a line which is either the anterior margin of the sacrum or a prolongation of it. A line at 90° to the articular surface is now erected at this point of intersection. It is believed that this line should pass well in front of the antero-inferior margin of the 5th lumbar unless there is an anterior displacement of this vertebra.

Stewart, William H. Abscess of the lung, roentgenographically considered. *Ann. Clin. M.*, March, 1924, ii, 312–328.

Roentgen examination locates the suppurative lesion, and also gives information as to the extent of the process and the presence or absence of associated pathological conditions like empyema. Early pulmonary abscess appears roentgenographically as a pneumonitis of varying degree depending on the amount of secretion present. Usually, the more acute the infiltration, the more dense the shadow. Old abscesses have definite pyogenic membranes and are readily outlined roentgenographically.

Multiple lung abscesses are present more often than suspected. No case is completely cured unless all roentgen signs have disappeared, even though the patient be symptom-free. The differentiation of lung abscess from small sacculated empyema is often very difficult. The tuberculous lung, because of its freedom from infiltration surrounding the cavity is easily differentiated. Sarcoma of the lung usually remains unrecognized until autopsy.

The roentgenologist can usually decide on the best method of treatment of a lung abscess. Simple bronchoscopy should commence early, and if it fails surgery should be tried. The roentgenologist should cooperate with the surgeon in localizing the lesion. This is best done during a definite phase of respiration with the patient in the surgical position.

The ideal method of localization is by means of roentgenoscopy in 2 planes, as advocated by Manges. The lateral position, with tube in front, is valuable for the diagnosis of lung suppurations. Ten cases are illustrated with roentgenograms.

Wallace, W. H. Spondylitis—a submerged entity in the diagnosis of obscure conditions in the abdomen. *Radiology*, May, 1924, ii, 307–310.

Many obscure abdominal conditions may have as their cause an unsuspected spondylitis. In a superficial survey, the author found most of his cases in men. The condition affects the intervertebral spaces and not the bones; and it can be readily diagnosed roentgenographically. Calcification and rigidity of the spine are not always the final stages. Five cases are cited. The different forms of the disease seen in the roentgenogram are different stages and not various types of infection.

Wilsey, R. B. The measurement of intensifying factors of *x*-ray intensifying screens. *Radiology*, May, 1924, ii, 311–315.

The conditions for exposing screens for test are: 60 kv., 4 ma., 20 inch target-film distance and 1 cm. Al. filter. Intensifying factors determined with 1 cm. Al. can be reduced to those for 15 cm. water by multiplying by the correction factors, 0.83 for single screens and 0.78 for double screens. A sensitometer or exposing machine was used for giving the same series of exposures to both halves of the film. The densities on the film were read with the photometer, density-exposure curves plotted, and from these curves the relative exposures found which gave equal densities on screened and unscreened portions of the film. The ratio is multiplied by the appropriate correction factor for scattered radiation to obtain the intensifying factor. This method was tested on a number of screens and checked by radiography of a wax knee. The results were in good agreement.

A test of contact between intensifying screen and film in a cassette with rigid cover lined with hard felt showed poor contact due to bulging. Good contact was restored by reinforcing the cover padding with thick soft felt.

Birch-Hirschfeld. Radiation treatment of malignant tumors in ophthalmology. *Deutsche med. Wchnschr., Berl. & Leipz.*, March 28, 1924, l, 401–403.

This summary is based on 20 years' experience and 452 cases of which 26 came under the author's direct observation. Malignant tumors of the eyelids, cornea and interior of the eye come under treatment sooner than do those in other parts of the body; and effects of treatment are fairly easily followed.

Epitheliomas of the lid and conjunctiva respond readily to radiation treatment, but recurrences are rather frequent. The author had 8 such cases, 4 of whom had recurrences. Surgical treatment is almost always necessary; and radiation is to be used as an accessory, the eyeball being protected from the rays so far as possible.

Epibulbar tumors given combined roentgen-ray and radium treatment often recede permanently, but a glaucoma appears as a secondary result of the radiation.

Retinal glioma and sarcoma of the choroid respond to irradiation with hard rays, but the result is only temporary. The same may be said for orbital tumors.

Hypophyseal tumors, on the other hand, have been irradiated apparently with success. At least 45 out of 54 such cases have shown positive improvement.

Engelmann, G. A case of congenital femur defect with post-natal development of the bone. *Fortschr. a. d. Geb. d. Röntgenstrahlen, Hamb.*, 1923, xxxi, 267–277.

No bony femur could be found by palpation or by roentgen rays in a girl nineteen days old. However, it was later found that a connective tissue, cartilaginous rudiment existed. For the purpose of later insertion of a transplanted piece of bone extension, an abduction of the lower extremity was made. But quite unexpectedly, a femur developed. A shadow as large as a lentil could be seen during the second month in the distal diaphyseal portion. In the fourth month the development was surprisingly rapid. The bone consisted of three parts, and looked as though it had been fractured. The center of the developmental delay was in the flexor side of the sub-trochanteral portion of the shaft. A well-developed, somewhat heavy femur formed with normally functioning adjacent joints, and reached a length of 11 cm., at the age of two. The length of the femur on the opposite side was 22 cm. The femur which developed late remained considerably shortened. Walking was good, and only a high sole necessary. The author considers as irrelevant the classification into 5 groups for the anomaly. In the above case he saw 3 of the 5 types developing during the course of growth. A simultaneously existing defect of the left hand which lacked the fourth and fifth fingers would suggest a genotype etiology.

Holthusen, Hermann. Biological standardization of roentgen rays with Ascaris ova. *Klin. Wchnschr.*, January, 29, iii, 185–186.

The method is suggested for the biological standardization of a dosimeter for different varieties of radiation, or for comparison of the biological effects of different apparatus, or of the same apparatus with different filters.

Procedure A makes use of the freshly extracted ripe ova of *Ascaris megalocephala*. Pin-head quantities of the eggs are placed on a celluloid plate and irradiated. Procedure B provides for anaerobic storage of the ova for 2 or 3 weeks during which period the eggs retain a diminished but constant sensitivity. After exposure to the radiation, the ova are incubated for 4 days at 37°C. and a count is made of the normally and abnormally developed organisms. The result is recorded as percentage injury.

This percentage injury has been found to be dependent on the product of the time of exposure and the intensity.

The method permits determinations in very small areas of the radiated field and can thus distinguish variations in intensity. The ova of a single female are quite constant in their sensitivity, and this sensitivity appears to be independent of the temperature between 4° and 37°C.

Holthusen, Hermann. Methods of biological standardization in roentgen therapy. *Klin. Wchnschr.*, January 29, 1924, iii, 199–201.

In this bibliographic review are given the reasons why the purely physical methods (ionization, etc.) of roentgen ray standardization are inadequate in establishing units of value in roentgen therapy. The photoelectric and the photochemical effects of the rays are related but not identical. Biological standardization is obviously a necessity.

The normal adult skin was the first to be used as a test object and served as the basis for the so-called skin unit dose. This was found to vary as much as 30 per cent in the hands of different operators. Then followed tests utilizing mice and tadpoles, but these did not find acceptance.

The bean reaction of Jüngling was a distinct advance, but the individual variations made results unreliable. This is obviated in the Holthusen test in which 300 to 500 *Ascaris* ova are used at a time, and which yields results reproducible to within 10 per cent. This method, however, gives relative values only and is most valuable for comparison purposes.

Use of transplantable tumors, of bacteria and of enzymes as test objects for roentgen ray standardization has not proven successful.

Klewitz. Radiation treatment of malignant tumors in internal medicine. *Deutsche med. Wchnschr., Berl. & Leipz.*, March 28, 1924, l, 399–401.

The Siemens & Halske symmetry apparatus was used in conjunction with a Coolidge tube and copper-aluminium filter. The aim in treatment was to impose the maximum possible amount of radiation upon the tumor.

Though notable relief was given in granulomas, the radiation treatment did not prolong life on the average in the 24 cases reported upon. The average survival after beginning of irradiation was 8 months; although 6 out of 16 survived from 4 to 6 years.

Carcinoma of the esophagus was given combined radium and roentgen-ray treatment. In 15 out of 16 cases, the survival was a matter of weeks or a few months. Gastric carcinomas (28 cases) ran similar brief courses; and in a large number of intestinal carcinomas, there was but one case showing apparently favorable results. Pulmonary and pleural carcinomas (30 cases) cause an equally high mortality; but in general, it seems that intensive radiation prolongs life somewhat. Two survivals reported in 8 cases of mammary carcinoma are credited to timely surgical treatment.

Sarcomas respond temporarily to radiation treatment, but the result in general is but a delay of the catastrophe. In practically all the above cases, surgical intervention was deemed inadvisable, so that the results must be considered with this fact in mind.

Klewitz, Felix. Brief review of 85 radiated cases of asthma. *Klin. Wchnschr.*, February 5, 1924, iii, 228–229.

The results in 85 cases of bronchial asthma treated systematically with roentgen rays are summarized. Of these, 26 (or 30 per cent) had no further attacks after treatment; and 27 (or 32 per cent) remained free from symptoms for a few months, but later developed attacks which were much milder than the original. Resumption of roentgen treatment in the latter cases almost always resulted in elimination of the symptoms. There were 12 cases (14 per cent) in which relief was obtained for a few weeks followed by the return of milder attacks; 20 cases (23.5 per cent) showed no improvement.

Krause, P., and Käding, K. Use of barium sulphate in medicine, with special reference to the toxicology of barium salts. *Fortschr a. d. Geb. d. Rontgenstrahlen, Hamb.*, 1923, xxxi, 231–250.

Barium sulphate was introduced into roentgenology as a contrast medium by P. Krause in 1910. It is non-toxic, without taste, has no effect upon gastrointestinal function, and is cheap. In 1921, following a death, Aust and Kron concluded that numerous accidents must have occurred previously but had not been made public. They sent a questionnaire to the larger roentgen clinics and institutes, receiving 31 answers. In all these answers, which included about 120,000 roentgen examinations, no detrimental effect was noted. In all these clinics purified barium sulphate preparations were used. Pure barium sulphate is non-toxic on account of its insolubility. Danger arises only where it is adulterated by other soluble barium salts.

In medicine barium chlorid plays a part on account of its action resembling that of digitalis, and barium sulphate has been given in gastric and duodenal ulcer, dysentery, enteritis and proctitis, with good success.

In roentgenology barium sulphate is used; (1) for the examination of the entire digestive tract; (2) in the diagnosis of urethral diseases;

(3) for dactyloscopy in criminal cases; and (4) as a protective against roentgen rays.

In urology barium sulphate is used for demonstrating old pseudo-ducts, urethral fistulas, diverticula and strictures. According to Kurtzahn a suspension of one part barium sulphate and three parts water is employed in this work. The barium is introduced slowly with pressure by means of the Nelaton catheter.

Merck, E. Strontium bromide as a contrasting material. *Deutsche med. Wchnschr., Berl. & Leipz.*, March 28, 1924, l, 411.

Strontium bromide for use in roentgen-ray observation of the blood vessels must be free from poisons. The ordinary material on the market contains more or less barium. A test for a satisfactory strontium bromide is the following: Dissolve 5 grams strontium bromide in 100 c.c. water, and add 5 c.c. of a 5 per cent solution of neutral potassium chromate. No precipitate should occur within an hour.

Mühlmann. Results of radiation treatment in uterine carcinoma. *Strahlentherapie, Berl.*, 1923, xvi, 137–143.

This article gives a summary of the results over a period of 8 years obtained from radiation therapy of inoperable carcinoma of the uterine neck. The lasting curve in 10 to 20 per cent coincides with the results of other authors. In the beginning radium only was employed, later a combination of radium and roentgen therapy, as it is carried on at the Erlangen Clinic. The Dessauer-Warnekros method which was used for one year did not yield equally good results and was abandoned. Individualized and cautious procedure is recommended. The healthy tissue and the blood should be protected; and the author warns against overtreatment. He considers radium application in relays favorable, and advises a simultaneous roentgen application as employed in the Erlangen technique, but distributed over a period of from 3 to 4 days. Larger tumors with a tendency to cachexia should be treated with smaller, more frequent doses. In operable carcinomas he does not think that roentgen treatment can be recommended as the method of choice, although physicians estimate the results from radiation treatment and operation equally good.

Sick. Hypostatic abscesses in the thoracic cavity, and their treatment by dorsal puncture. *Klin. Wchnschr.*, February 5, 1924, iii, 218–220.

From the standpoint of diagnosis, there is special interest in that stage of the disease in which the clinical picture offers but few definite features (such as vague backache, tuberculous stigma, previous pleuritis). Here, the roentgen picture is an important and deciding factor. Sagittal exposures are quite necessary, and transverse ones are desirable. The former reveal the presence and location of the hypostatic abscess, and the latter often show more precisely the location of the vertebral lesion as well as the position of the pus cavity with respect to the diaphragm.

Adson, Alfred W., Ott, Wm. O., and Crawford, Albert S. A study of ventriculography. *Radiology*, Feb., 1924, ii, 63–73.

This is a report on 75 cases. In those cases in which the histories or findings are questionable or indeterminable the writers resort to ventriculography for aid in localization of incipient brain tumor, rather than defer diagnosis and treatment until lesions become extensive and result in permanent injury. If ventriculography makes it possible to detect the operable cases earlier and to eliminate the inoperable, its use is justified. Details are given for withdrawing the fluid from the ventricles and for the introduction of air and making of the roentgenograms. A head rest has been developed which will hold the head accurately in position, at the same time permitting the films to be inserted and withdrawn without disturbing the position. Interpretation of these roentgenograms will require considerable study.

Bloodgood, J. C. The message of Dr. Joseph Colt Bloodgood and the Maryland Cancer Commission. *Boston M. & S. J.*, April 24, 1924, cxc, 726–727.

The surgical pathological laboratory of Johns Hopkins Hospital has 40,000 records which show a falling curve of inoperability, a rising curve of five-year apparent cure, and longer permanent cure. The improvement is most marked in cancer of mouth, skin and breast. It is becoming noticeable in cancer of the cervix. There is little improvement in cancer of stomach and colon.

Recent evidence shows that many cancers originate in benign polypoid growths. These growths give definite symptoms in the benign stage, can be felt with the finger, can be seen with the proctoscope or outlined with roentgen ray.

Carman, R. D., MacCarty, W. C., and Camp, J. D. Roentgenologic diagnosis of cholecystic disease. *Radiology*, Feb., 1924, ii, 80–89.

A clinical diagnosis of cholecystic disease was made in 5 per cent of all cases observed in the Mayo Clinic in 1922. In the last 100 necropsies, gall-bladder disease was found in 64 per cent.

MacCarty found but 17 normal gall-bladders in a series of 5,000.

The patient is prepared by catharsis and enemas over night. With the patient prone, 4 or more roentgenograms are taken of the area from just below the iliac crest to the 9th rib, each one overlapping the other. A 2-in. cone is used, the medium focus tube tilted 10° toward the head; distance, 24 in., 50 ma., time, 2.5 sec.; 43 to 56 kv. according to size of patient. The patient suspends respiration while exposure is made.

The shadows of liver and kidney are differentiated, and a third shadow between the 10th rib and the iliac crest may represent the gall-bladder. Its most common location is just below the 12th rib, and it appears as an elongated and rounded shadow on which that of the kidney is often found superimposed. A diagnosis should not be attempted unless the shadow of liver and kidney can be identified. Adhesions following operation involving loops of bowel or omentum may produce shadows not unlike those of the gall-bladder. The number of gall stones seen is no clue to the total number.

Ballenger, E. G., Elder, O. F., and Lake, W. F. The demonstration of prostatic enlargement by the roentgen ray. *J. Am. M. Ass., Chicago,* March 29, 1924, lxxxii, 1023–1024.

Intravesical prostatic hypertrophy, median lobe enlargements and similar conditions can be clearly demonstrated by air cystograms with the patient prone. The technique is as follows: All preliminary preparations are made before the bladder is inflated, the bowel and rectum being cleared by castor oil, followed by a soapsuds enema. The patient is placed on the Bucky diaphragm, the residual urine is catheterized and preparation for dilating the bladder is made. The patient is then placed prone and fastened in position. The tube is adjusted at a 20° angle so as to direct the rays upward through the pelvic ring, the bladder is slowly and gently inflated and the exposure made promptly. The inflation is continued until the patient complains considerably of the pain. After exposure, the air is allowed to escape slowly. Over-exposure impairs good results.

Hohlweg, H. On avoidance of errors in roentgen diagnosis of ureteral calculi. *Ztschr. f. Urol.,* 1923, xvii, 533–535.

Sometimes the shadows seen in the course of the ureter are so indistinct that one is in doubt whether or not to diagnose a calculus. Not even after introduction of a ureteral catheter is the result beyond doubt. If the shadow coincides with the probe a stereoscopic roentgenogram must be made (Zondek). The author, in accordance with Belá and Mezö, in these instances recommends the introduction of a ureteral catheter as far as possible into the ureter, followed by a 10 per cent barium sulphate injection, through it. If the calculus completely occludes the ureter the solution will not penetrate beyond the point of its location, but will define the calculus more clearly. If the barium should penetrate beyond the calculus the renal pelvis is filled, and the calculus will be more distinctly seen than before. If the shadow is outside the ureter the shadow will remain unchanged. Only in rare instances of ureteral diverticulum would the intensity of the shadow remain uninfluenced.

Holzknecht, G. The margin of safety in direct measurement of the surface dose in roentgen therapy. *München. med. Wchnschr.,* 1923, lxx, 1311–1312: *Radiology,* Feb., 1924, ii, 59–61.

Direct measurements are safer in roentgenology than indirect ones. It is a simple method to go by the clock, but it is insufficient for the avoidance of injuries. Where hundreds of exposures are made it is impossible to avoid accidental changes in the apparatus. The author therefore recommends the use of two measurements, one independent of the other. The exposure should cease when one of the measurements indicates the borderline. The author recommends the dosing tables which he has published for the direct measurement, and time exposure for the indirect method. On this basis measurements on the phantom are made. Errors of exposure, such as forgetting the filter, and errors in focusing the distance from the skin are shown up by the direct dosimetric methods, and are eliminated.

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